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MAORI FORTIFICATIONS OF THE OKATO DISTRICT, TARANAKI

NIGEL PRICKETT

AUCKLAND INSTITUTE AND MUSEUM

Abstract. Twenty-seven pre-European Maori fortifications are described from the Okato district, Taranaki, North Island, New Zealand. Many of the sites have ring-ditch defences and show marked similarities to forms in previously surveyed districts to the north. Changes in natural topography towards the south-west margin of the survey area, however, have resulted in a change from ring-ditch forms to fortifications in which artificial defences cut off sections of natural terrace, or in three cases, lahar mounds, which are backed up against coastal or river scarps.

This paper concludes the description of pre-European Maori fortifications of the region between New Plymouth and Stoney River (Hangatahua) in Taranaki, North Island, New Zealand. A background to the programme and the reasons for undertaking the research have already been published along with the results of first year's field work in the Omata and Oakura districts (Prickett 1980). The second season's field work, in the Tataraimaka district, has also been published (Prickett 1982). The present paper reports sites which were surveyed in the third field season in the Okato district between Katikara River and the right bank of Stoney River. There remains the overall analysis of results to be completed and published at a later date.

A general description of the programme area has already been given. Topographically the Okato district consists of extensive terraces cut by the steep-sided valleys of rivers and streams. Two of the major rivers, the Katikara and Kaihihi, have their origins on the western flank of the Pouakai Range. To the south, the larger Stoney River rises in the Ahukawakawa Swamp which occupies an extensive valley between the Pouakai Range and Mt Egmont. Smaller streams drain limited areas seaward of the main South Road. The terrace country itself dips north-west to the coast. Towards the mouth of Stoney River the terrace country is generally lower than elsewhere. Over most of the survey area the landscape is thickly mantled with ash. On the right bank of Kaihihi River this changes to a landscape dominated by lahars of the Pungarehu Formation and, to the right bank of Stoney River, to Warea Formation laharic conglomerate and the alluvial sand and gravel of the Hangatahua Gravels (Neall 1979).

Maori fortifications of the Okato district are rarely more than 5 km from the sea. The twenty-seven recorded pa include the historically important Mounu Kahawai. Ngaweka (N108/80), on the left bank of Hangatahua, perhaps the most important pa in what is generally regarded as the Okato district, is not included here as this survey extends only to the right (north) bank of the river. The survey area falls within the traditional territory of the Nga Mahanga *hapu* of the Taranaki tribe.

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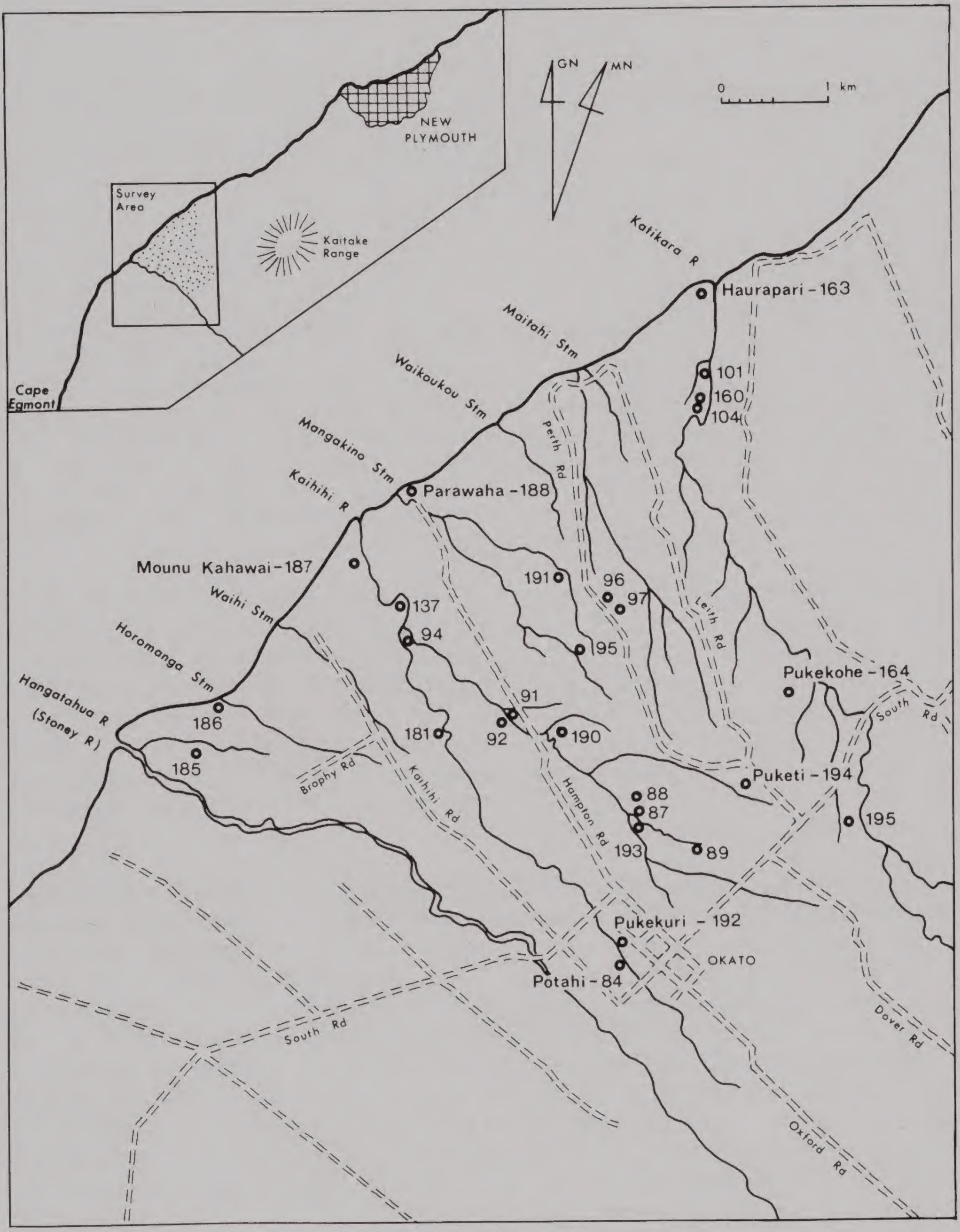

Fig. 1. Distribution of pa in the Okato district, Taranaki.

Steep scarp
Moderate scarp
Small scarp
Stone-faced scarp

Slope change
Rua
Depression
Ditch

Base of cliff
A —— Section
Fenceline

Key for Figs. 2, 4, 5, 7, 8, 10, 13, 15, 16, 18, 19, 21-25, 27.

This paper reports the results of three weeks work by one field team in November and December 1981. Most sites were mapped by alidade and plane table. Others were surveyed by tape and compass and 'dumpy' level as topography and vegetation cover required.

The survey area falls within the NZMS 1 series map N108 (New Plymouth). Map references are from the third edition, 1970. Site numbers refer to the New Zealand Archaeological Association site recording scheme. Except where stated, names ascribed to pa were obtained from the original Lands and Survey Department blocksheets covering the Cape Survey District, which are now held in the Lands and Survey Department district office, New Plymouth. The 1950 aerial photographs referred to are from the New Zealand Aerial Mapping Ltd (Hastings) series, which are held by the Lands and Survey Department.

The distribution of pa within the surveyed area is shown in Fig. 1. Presentation of individual sites is organised geographically by stream or river catchment areas working in general from east to west through the district.

N108/195 (487766) Fig. 2

N108/195 is one of the rare pa located inland of the present main road in the Tataraimaka and Okato districts. More than 5 km from the sea, it is the furthest inland of 15 fortified sites within the Katikara River valley. It is 1 km south of the major pa Pukeporoporo, across the river (see Prickett 1982:36-38). N108/195 occupies a narrow ridge between terrace country north and south. The rectangular earthwork can be seen beneath gorse in the 1950 aerial photograph (1791/9), but with a farm access track already making use of the ditch and bank along the north-east side. The site has since been substantially destroyed. The transverse ditches at both ends are gone and the western half

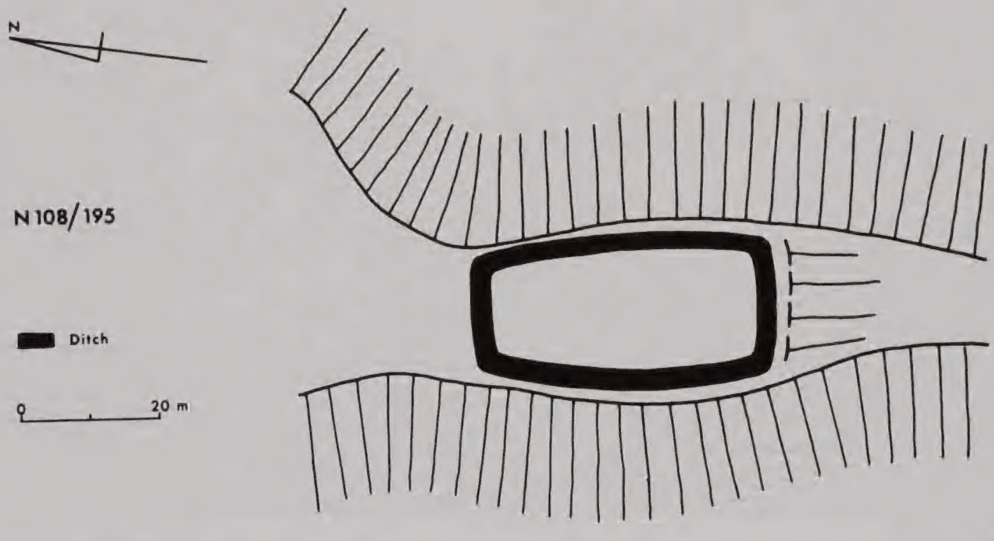

Fig. 2. Reconstruction of defences of N108/195.

of the platform is cut down 2 m to ease access along the narrow ridge. All that survives is the ditch along the south-west flank with its 4 m platform scarp and lower outer bank. The site is now under grass with some small native trees on the surviving platform scarp.

Natural defences include steep 12-15 m scarps into adjacent gullies on both sides. The site stands higher than the terrace country to the north, while to the south-east, higher ground is 80 m away. Artificial defences involved a single encircling ring-ditch.

The destroyed living platform of this pa measured 40 x 18.5 m, giving an area of *ca.* 700 m^2.

Pukekohe N108/164 (481778) Figs. 3, 4

Pukekohe occupies the top of a prominent hill standing high above the Katikara River valley, 500 m west of Pukeporoporo. The hill was formerly topped by the trig 'Langley', 106 m (348 ft) above sea level. Despite its elevated position, however, Pukekohe does not enjoy good command over nearby ground which is deeply dissected by tributaries of the Katikara River. The site is very badly damaged: the outer defensive bank is virtually destroyed and the clump of pine trees which now occupies the inner platform has very badly damaged what remains. It is now under pine trees and grass.

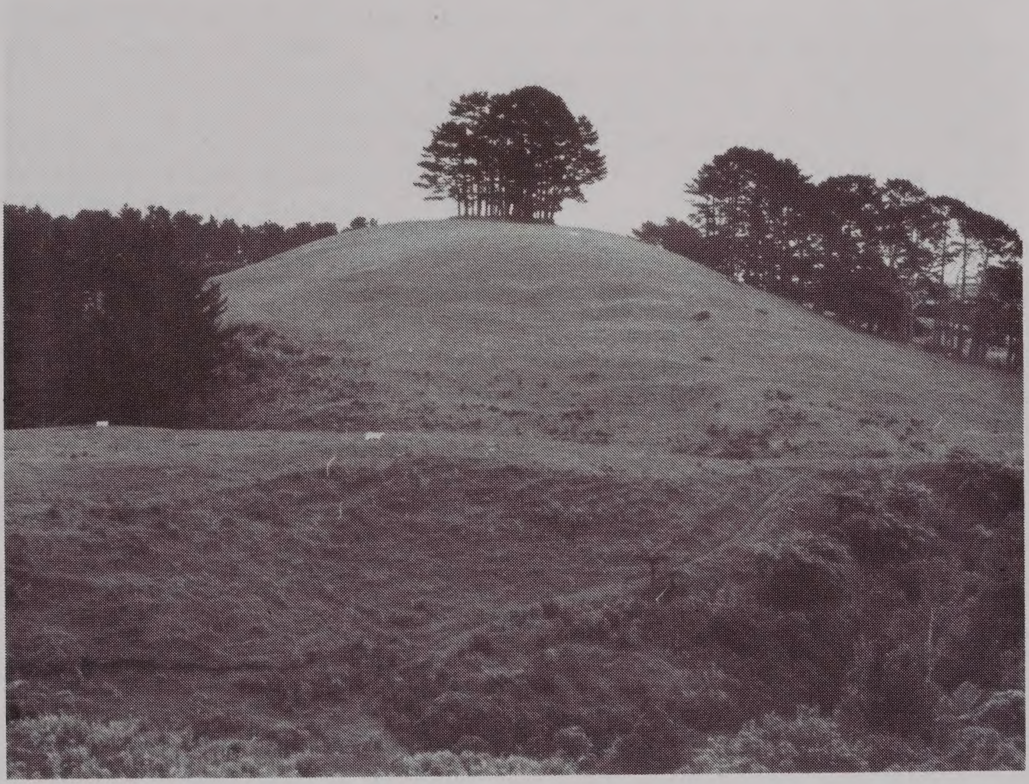

Fig. 3. Pukekohe (N108/164) — view west over Katikara River (1980) from Pukeporoporo (N108/90; see Prickett 1982:36-38).

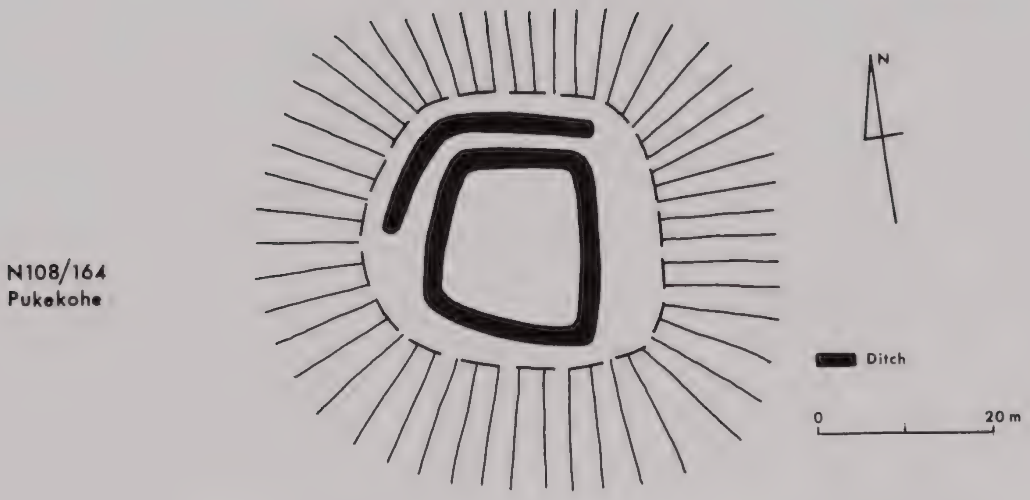

Fig. 4. Reconstruction of defences of Pukekohe (N108/164).

Natural defences consist of steep 40-50 m hillsides into adjacent gullies except to the south-west from where there is a relatively easy approach 20 m up from a slight saddle. In the 1950 aerial photograph (1790/6) Pukekohe can be seen as a square work defended by an encircling ditch and bank, with a second ditch enclosing the north-west and north-east sides. This form can be confirmed on the ground today despite damage suffered by the site.

The occupation platform now measures 19 x 17.5 m: allowing for erosion from the margins the defended area may have been 320 m^2. There is no sign remaining of internal organisation.

N108/104 (472807) Figs. 5, 6

N108/104 lies within a dense concentration of fortification sites in the lower Katikara River valley. Over the river to the south are N108/103, N108/102 and Pouteau (these sites are described, along with others on the right bank of the river, in Prickett 1982). To the west over the river are N108/161 and 162. On the left bank of the river (and introduced in the present article) are N108/160 and 101. The massive earthwork of N108/163 is at the mouth of the river 1 km away. Two hundred metres north-west of N108/104 is Porou (N108/105), a Taranaki, Ngati Ruanui and Whanganui fortification of the Second Taranaki War, which was taken by the 57th Regiment in the Katikara River engagement of 4 June 1863 (see Cowan 1922 I:219-221). N108/104 is now under pasture with some pine trees along the south-west margin. Some damage has been done in the past along both sides in the preparation of access to the valley bottom.

The present fortification occupies a powerful position bounded by a 30 m cliff to the Katikara River on the south-west side, with steep escarpments to the valley floor to the east. Only the north offers an easy approach from the extensive terrace country of the left bank of the Katikara River, on the very edge of which the pa is situated. Artificial defence consists of a single encircling ditch with an outer bank which, before damaged, would have extended from cliff top to terrace edge around the south-east and north-east sides.

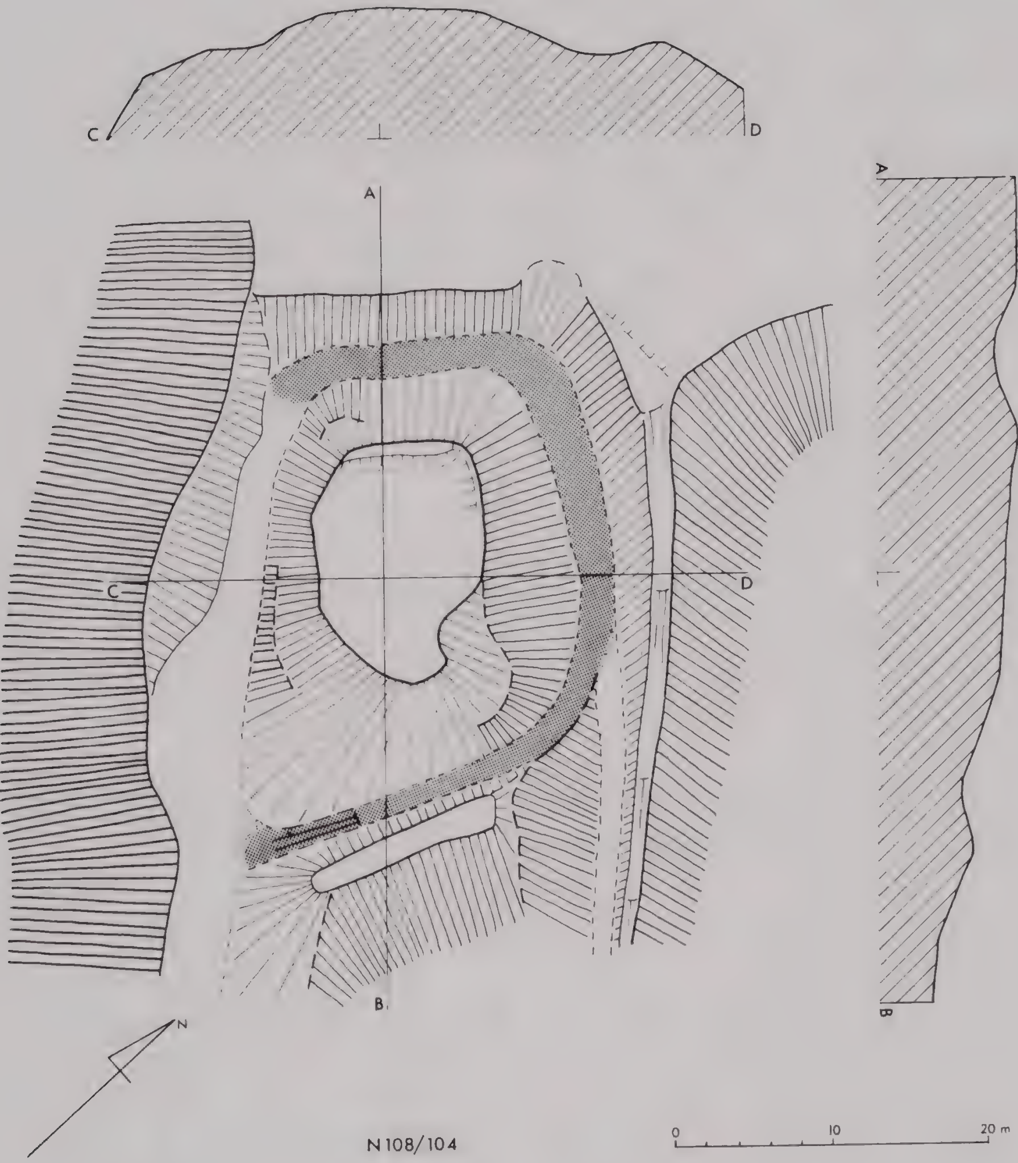

Fig. 5. Plan and sections of N108/104.

The platform scarp is now 1.5-2.5 m high. A pronounced rim bank survives at the vulnerable north-west side of the platform.

Erosion of the margins now obscures the basically rectangular plan of the occupation platform, which may originally have been 16 x 12 m in size (*ca.* 180 m^2).

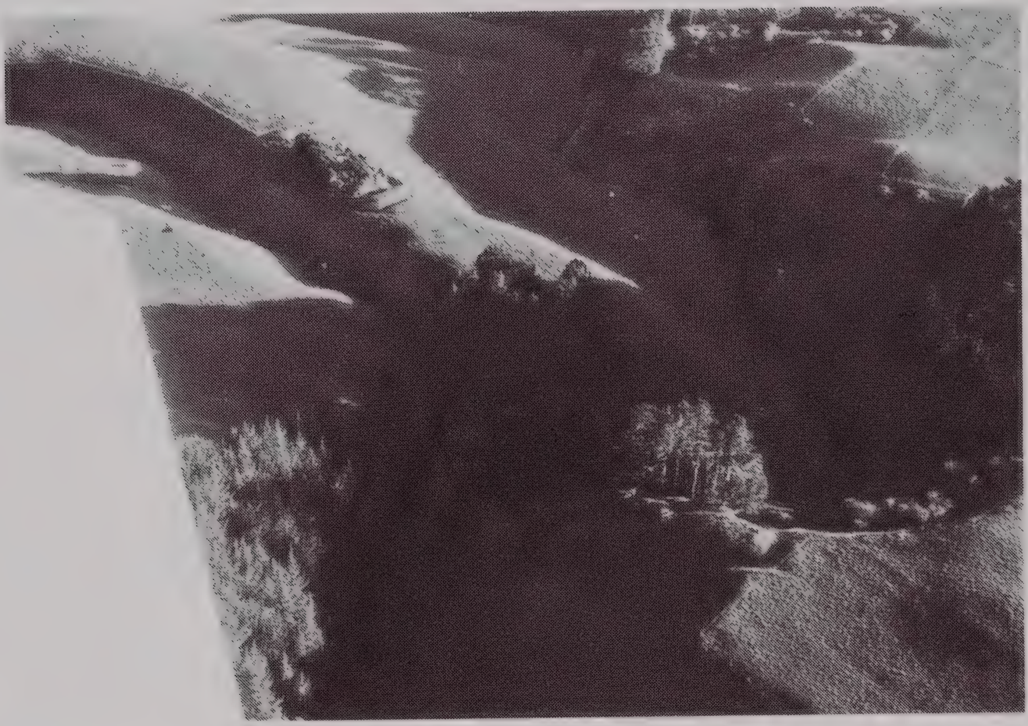

Fig. 6. N108/104 (right foreground) — aerial view from the north (1975). N108/102 visible over Katikara River (see Prickett 1982:43-45).

N108/160 (473808) Fig. 7

This small fortified site is situated on top of the escarpment on the left bank of Katikara River, 1 km from the sea. To the north is N108/101, while 150 m to the south is N108/104. North-west 150 m is the historic pa of Porou. N108/160 is almost destroyed by cultivation and is now under grass except at the terrace edge where dense boxthorn may obscure surviving earthworks.

Natural defences are strong only at the rear (south-east) side where there is a 25 m scarp to the Katikara River. The other three sides all offer easy approaches. Artificial defence consists of a single ditch and bank which can be traced around three sides of the fortification.

Present archaeological evidence indicates a rectangular, virtually level, defended area 18 x 10 m (*ca.* 180 m^2).

N108/101 (473811) Fig. 8

This fortification occupies an extensive spur above the left bank of Katikara River. It commands the river valley and the narrow gully to the west. The higher terrace edge is 200 m away to the north and west. N108/101 has been badly damaged by cultivation and little more than the transverse defences are now visible. The site is under grass.

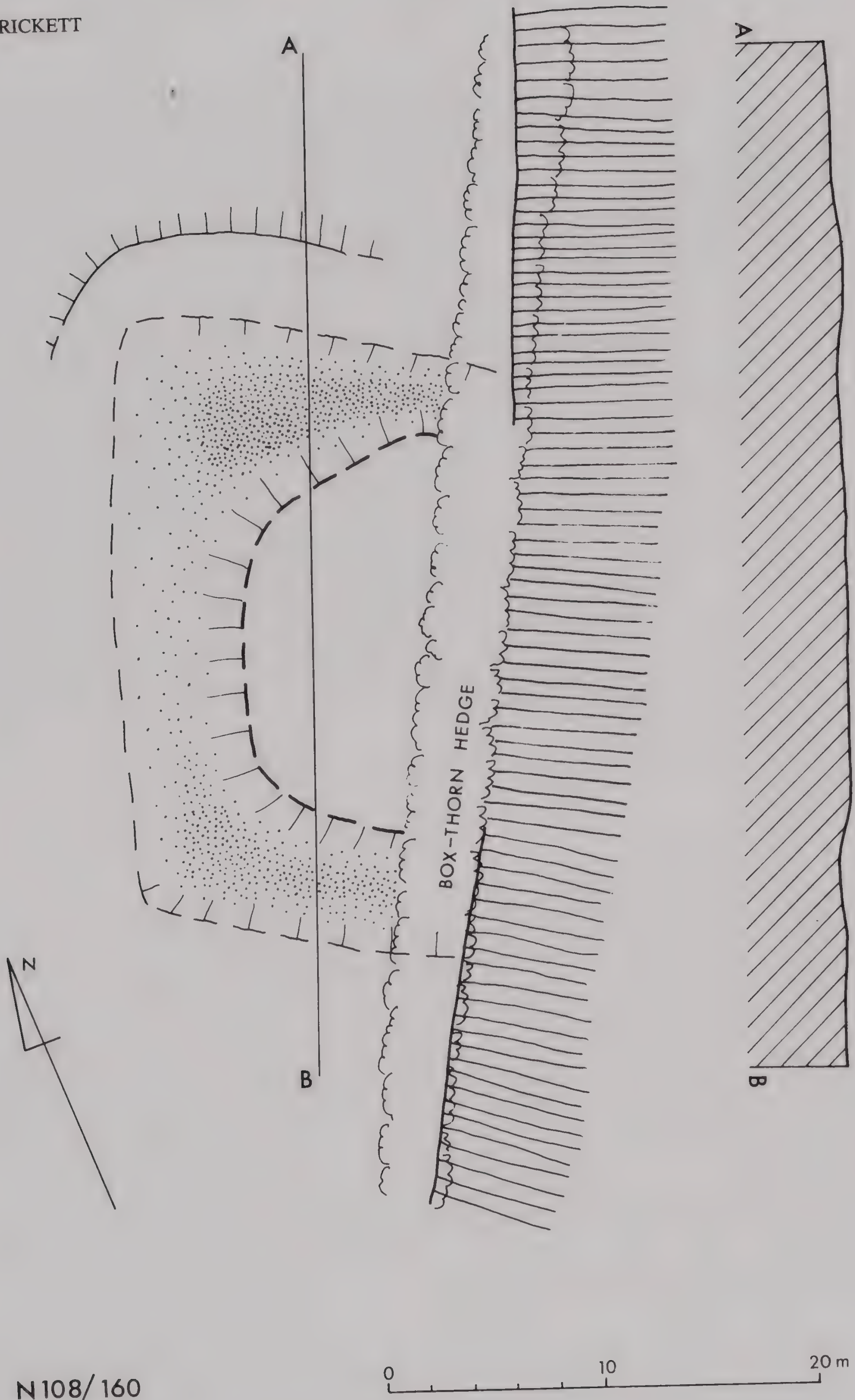

Fig. 7. Plan and section of N108/160.

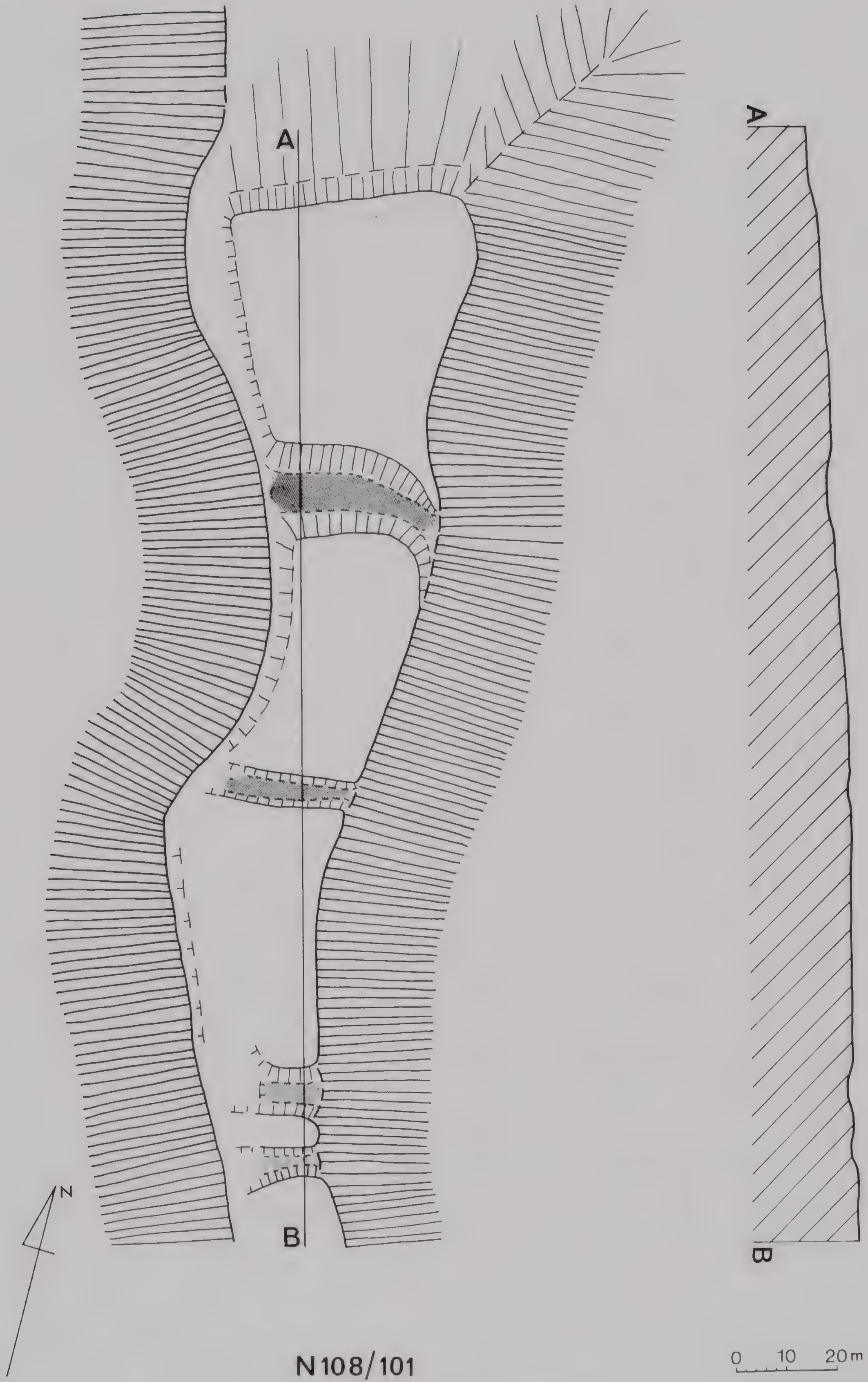

Fig. 8. Plan and section of N108/101.

Natural defences consist of steep escarpments, 15-20 m into the valley of the Katikara River east, and 12-15 m into the gully west. The broad end of the spur offers a comfortable approach from the river valley. Access is easiest down the spur from the terrace country to the south. Visible artificial defences comprise a double ditch and bank which cuts the spur at its narrowest point (20 m wide) at the vulnerable south end, two (possibly three) other internal transverse ditches, and terrace and scarp defence at the north end. Other terrace and scarp defence can be made out along the western flank of the three major occupation platforms and doubtless also occurred along the east side where the platform dips directly to the valley floor.

The occupation platforms dip slightly to the north. The site is made up of three or four separately defensible platforms. Within the double ditch and bank of the south-east end is a platform 50 x 22-28 m (*ca.* 1300 m^2) which may (from the 1950 aerial photograph, 1789/2) have been divided in two by an additional transverse ditch which the survey team did not pick up on the ground. The second platform, measuring 48 x 24 m (*ca.* 1100 m^2) has some indication of internal organisation in the form of a terrace at its eastern margin. The third platform is 50 x 30-46 m (*ca.* 1900 m^2): two or three dimples at the northern edge may represent *rua*. Including internal ditches the total area within the outer ditch of the south end is *ca.* 5300 m^2. On a small knoll within the gully beyond the northern defences are signs of terracing and possible *rua*.

Haurapari N108/163 (472819) Fig. 9

Haurapari occupies the rising northern extremity of terrace country west of Katikara River. It commands the beach north-east to the famous pa Tataraimaka, as well as the valley of the Katikara River to the east and the broad terrace country inland to the south. The site is *ca.* 30 m above the adjacent sea beach and river valley. In the 1950 aerial photograph (1789/2) only a short section of defensive ditch and bank remains intact. Since then it too has come under cultivation. Remaining archaeological evidence consists only of slight dips and rises in the paddock which signal the former ditch and bank defences.

Natural defences are strong at the north and east sides. Artificial defence consists of a formerly massive ditch and bank, 195 m long, which cuts the terrace from river scarp to sea cliff just at the point where a slight rise to the north gives some natural advantage. Twenty-five metres forward of this a second ditch and bank also appears to have originally extended across the terrace. Much of this second line of defences is now destroyed: a 70 m length of the northern part is still visible and the southern end can be seen where it meets the scarp to the Katikara River.

Within the inner ditch the defended area of this pa measures almost 200 x 80 m, giving a defended area of *ca.* 8500 m^2. If the area between the two lines of defence is added then the defended area totals *ca.* 10,000 m^2. The area within the defences has all been cultivated and shows no sign of internal organisation except for three or four possible *rua* outside the cultivated area above the cliff at the north-east edge of the site.

N108/97 (463787) Figs. 10, 11, 12

N108/96 and 97 are adjacent ring-ditch fortifications situated on the left bank of an eastern branch of Maitahi Stream, a little over 2 km from the sea, adjacent to Perth Road.

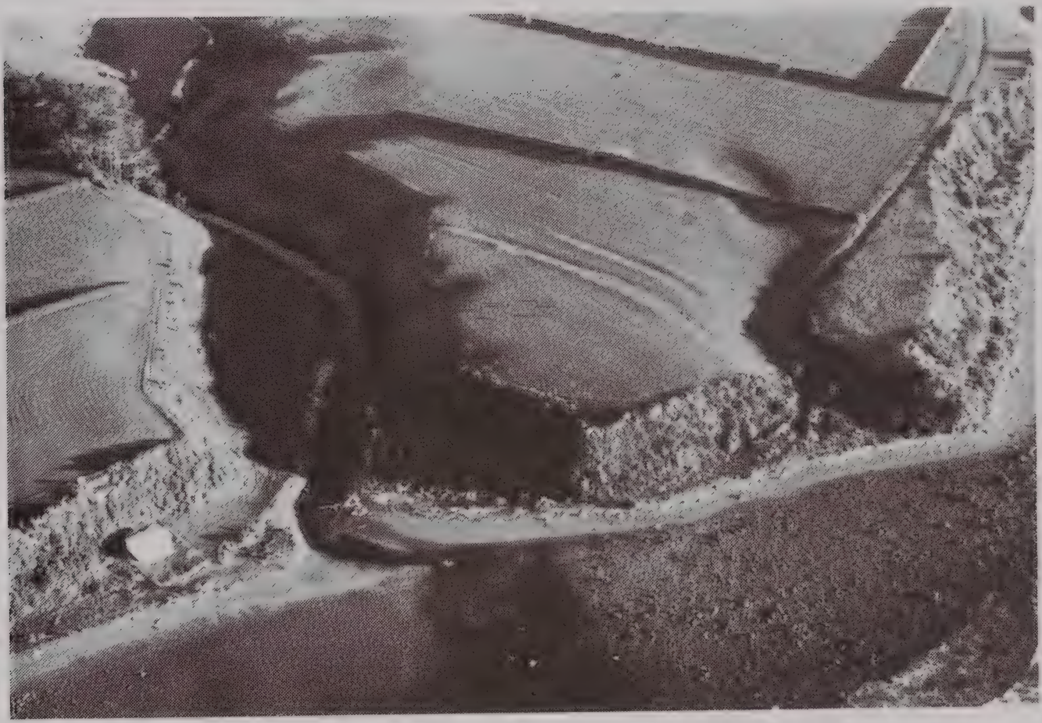

Fig. 9. N108/163 — aerial view from the north (1975).

N108/97 is under grass. It has sustained some damage in the past by farm access making use of the outer defensive bank at the north end. At present it is suffering severely from stock erosion.

N108/97 is a simple ring-ditch fortification. It makes use of a slight eminence bounded on three sides by gullies, and has command over adjacent terrace country except to the north-west where N108/96 occupies a higher knoll only 150 m away. The platform stands 12 m above the gully to the east and 6-8 m higher than the head of the gully to the west. It has a 3 m advantage over adjacent terrace country to the south; from which is the easiest approach. Artificial defences comprise a single encircling ditch and bank. Except where it has been destroyed the defensive bank is a very pronounced, rising sharply from outside the pa and standing as much as 3 m (at the upper, south-east, end) and generally *ca*. 1.5 m, above the ditch. The platform scarp is close to 3 m high all around. An abrupt rim bank at the vulnerable south-east end has almost disappeared through the present active erosion of the platform scarp.

The occupation platform dips 4.6 m from south-east to north-west. On it are upwards of eight terraces of various sizes and shapes, including a pronounced 6 x 5 m *tihi* at the upper end. Between the *tihi* and the platform rim bank is a line of four *rua*. Another eleven *rua* are scattered throughout the remainder of the platform. Outside the low north-west end of the fortification is a triangular platform, 12 x 15 m, with two *rua* on it. Another possible *rua* is below this platform to the north. The defended platform is 41 x 10-14 m giving an area of perhaps 480 m^2. The undefended area at the north-west end may give another 100 m^2 living space.

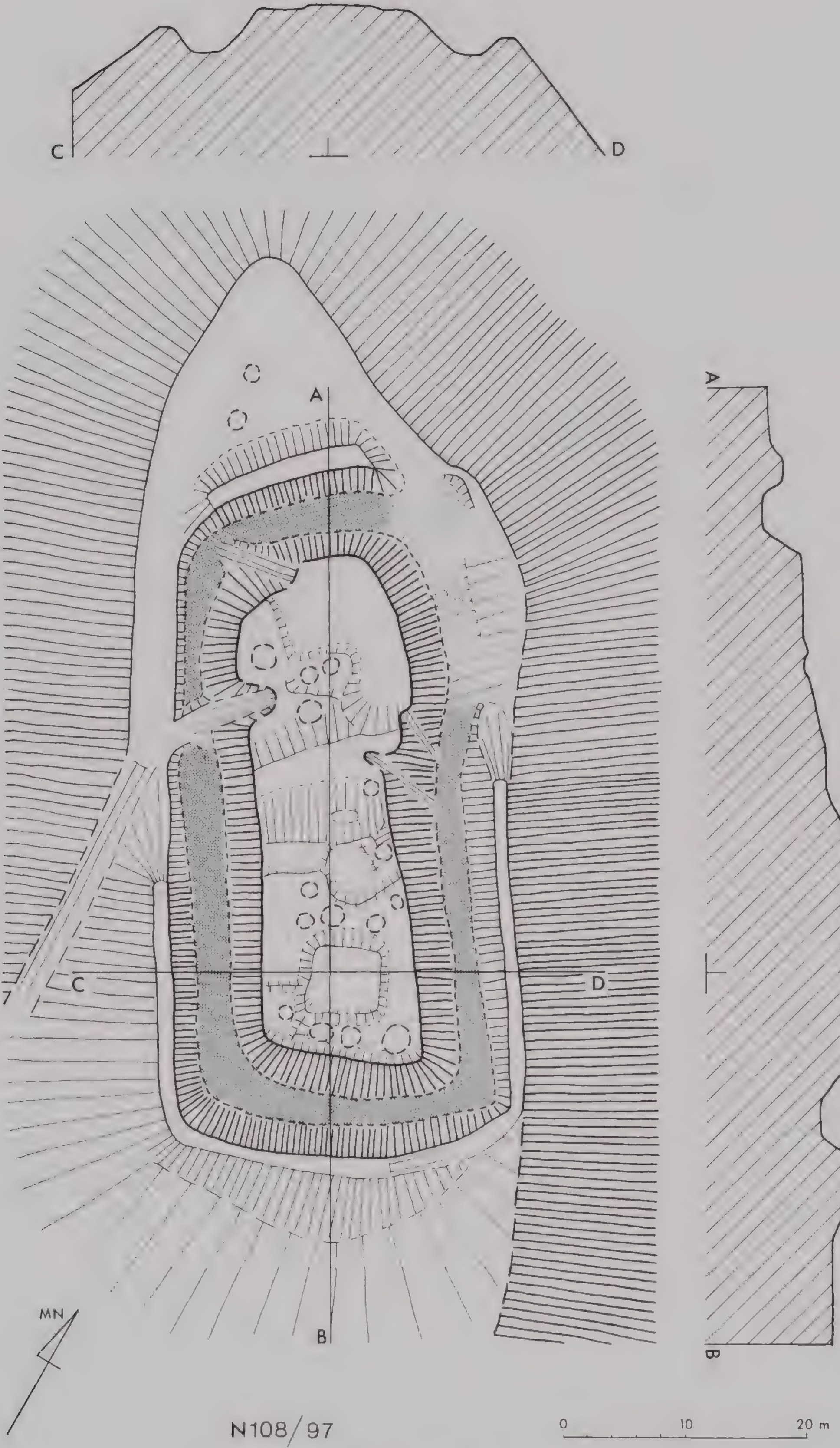

Fig. 10. Plan and sections of N108/97.

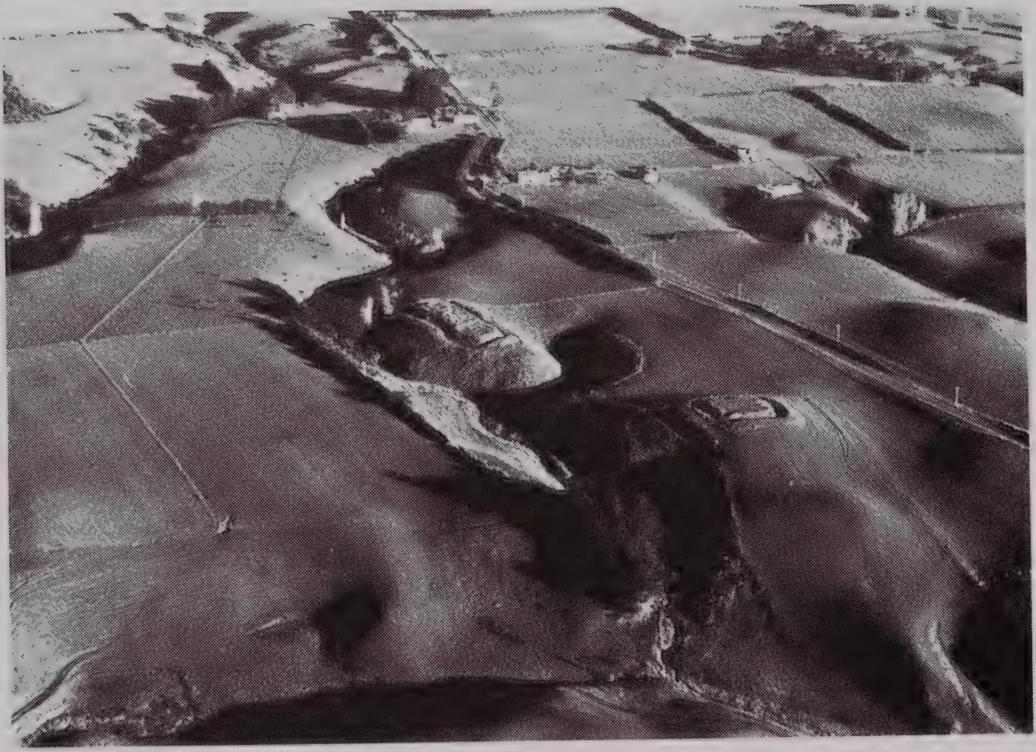

Fig. 11. N108/97 (left) and N108/96 — aerial view from the north (1975). Behind is Perth Road.

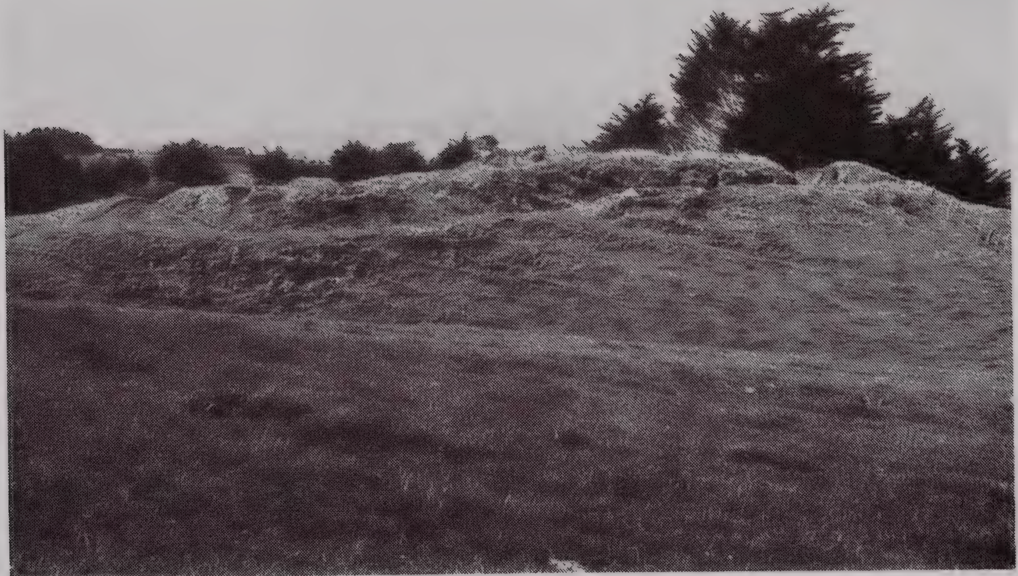

Fig. 12. N108/97 — view north-east from Perth Road (1975).

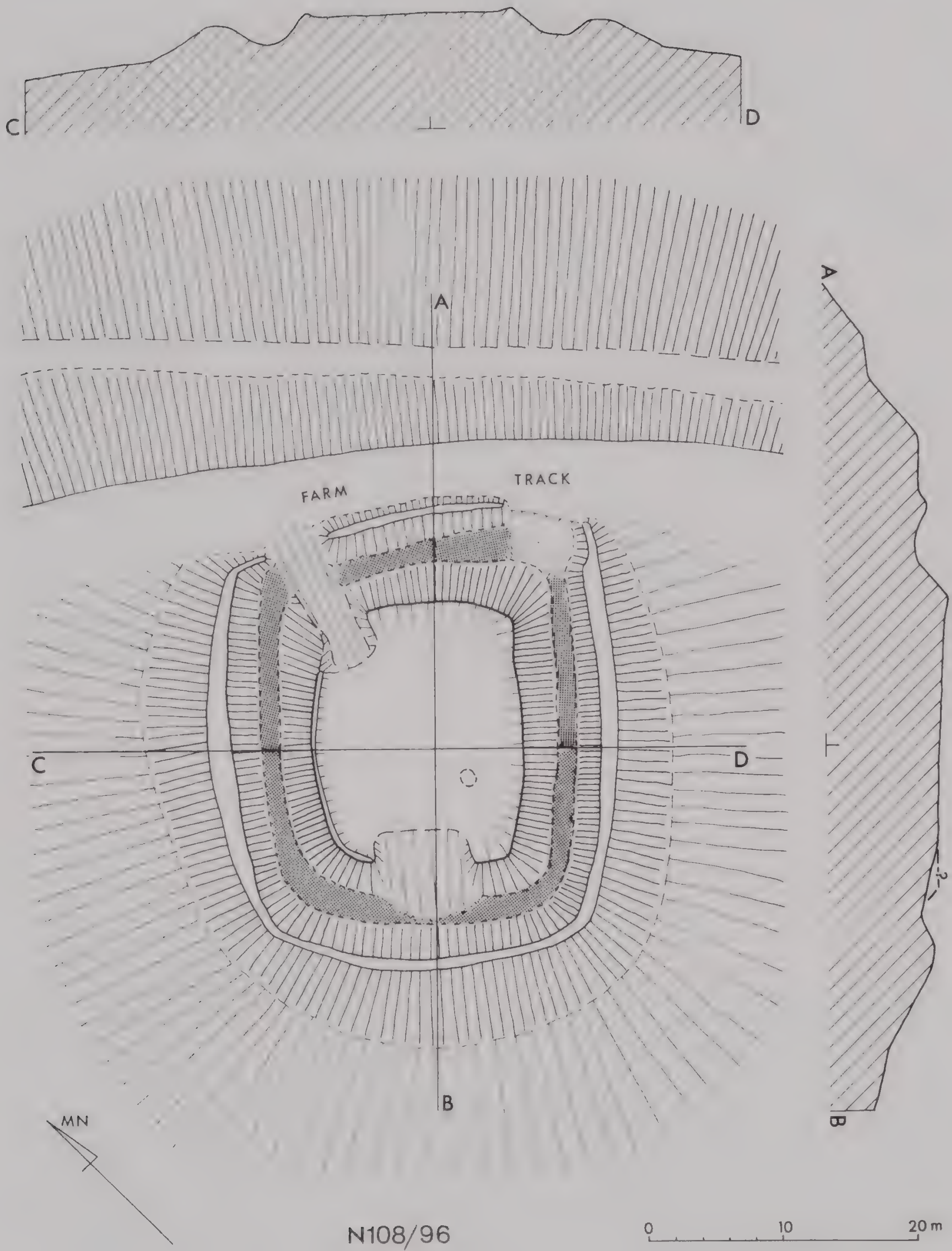

Fig. 13. Plan and sections of N108/96.

N108/96 (462788) Figs. 11, 13, 14

N108/96 is 150 m north-west of N108/97, on the left bank of a branch of Maitahi Stream, just east of Perth Road. It is higher than nearby N108/97 and so dominates the interior of the latter site which dips to the north. From their complementary locations it seems likely the two fortifications were sited for mutual support and are thus contemporary. N108/96 is now under grass with past bulldozer damage to the outer bank and platform margins, and some present stock damage.

Natural defences of the site are strong. To the east is a 15 m fall into the nearby gully. On the other three sides the pa stands well above steep approaches from adjacent low-lying ground. The site occupies a commanding position with views all around over nearby terraces and gullies. Artificial defences comprise a single ring-ditch and bank encircling the almost square platform. More than usually, age has softened the physical detail and sharpness of this site. Remaining evidence is for a counterscarp 0.75-1.5 m high and a main platform scarp *ca*. 2 m high. A slight rim bank (now most pronounced at the north-west side) may have encircled the platform.

The simple level occupation platform is 15 x 19 m (250 m^2). The only sign of internal organisation is a single *rua* towards the southern corner.

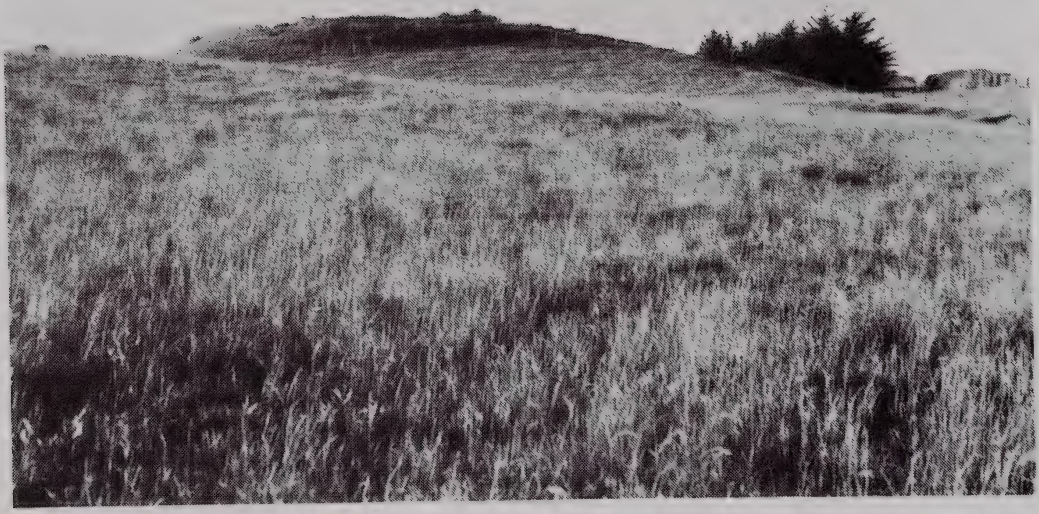

Fig. 14. N108/96 — view from the south (1975).

N108/95 (459783) Fig. 15

This small pa is situated on a slight saddle above the headwaters of the two main branches of Mangakino Stream. Flanked by two gullies it occupies the easiest route on to the terrace country which lies to the north-west. Its situation allows good natural defence over the gullies north-east (6 m below platform) and south-west (8-10 m), but little command over the slight saddle to the south-east and none over rising ground to the north-west. The site is now under grass with defences at both ends having suffered some damage in easing access along the ridge. Some slumping and erosion is occuring along the south-west flank.

Artifical defence consists of a single transverse ditch at both ends with a terrace, probably originally a ditch, along the north-east flank. The transverse ditches are now only 50 m deep. The remains of a slight bank can be seen on the platform rim at the more vulnerable north-west end. The defences seem hardly adequate for the situation.

At least seven *rua* appear to have been concentrated down the centre of the level occupation platform. The platform area is *ca*. 540 m^2 (18 x 30 m).

N108/191 (457790)

N108/191 occupies a high terrace edge above the left bank of the easterly tributary of Mangakino Stream, 500 m north-west of N108/96 and 97. The site is now virtually destroyed with only faint remains of part of the defensive ditch visible, along with some fragmentary shell midden spilling down the steep slope to the stream. The name 'Hauwai' is given on the old 'Wairau and Cape Survey Districts' cadastral map, marking a place which appears to be about 100 m south of N108/191. There is now no sign of any occupation at the marked point, but the present landowner reports shell midden and *rua* a further 1-200 m south on a low lying spur bounded by the branching stream. The name may refer to this apparently undefended settlement or to N108/191, the defended site under discussion here.

In the 1950 aerial photograph (1790/4) an angled ditch can be seen cutting the rising promontory from adjacent terrace country. The ditch has clearly already suffered considerable damage through cultivation. All that can be seen today is the 40 m southern part of this ditch on one side of the fence which now cuts both ditch and pa. North of the fence the ditch is no longer visible on the ground, although *ca*. 20 m further out in the paddock there are faint indications of another possible ditch. On the east side of the site, defences have been left to the 15-18 m scarp to the stream.

The defended area of the site is *ca*. 50 x 30 m and may be as much as 1000 m^2.

Parawaha N108/188 (442799) Figs. 16, 17, 26

Parawaha is located on a slight but commanding point of land on the sea cliff above the north bank of Mangakino Stream, *ca*. 600 m north-east of the Kaihihi River mouth. The pa is clearly a major site of the district both by its size and defences and by its commanding situation. There was a late nineteenth century *kainga* in the lee (east) of the earlier fortification: fragments of bottle glass and china are eroding from the scarp to

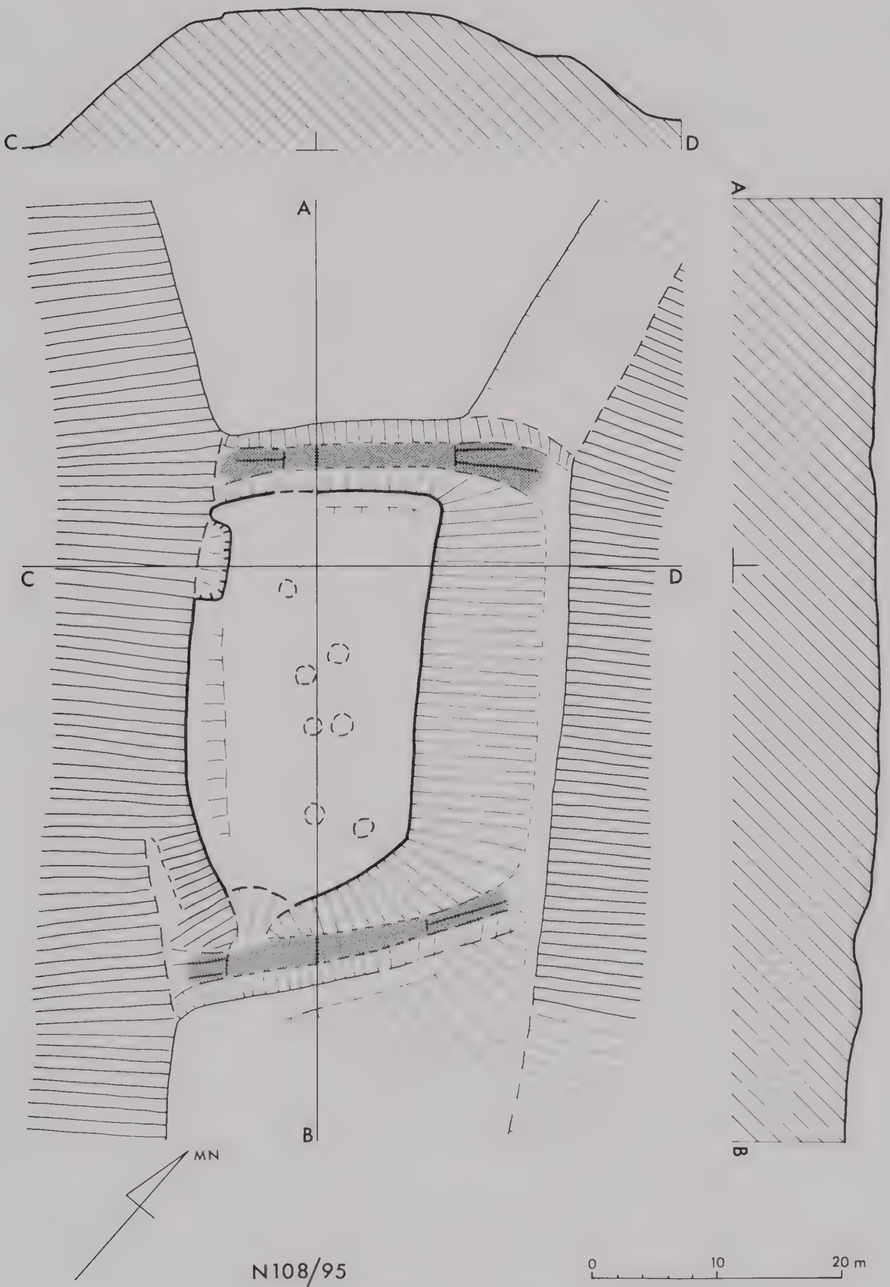

Fig. 15. Plan and sections of N108/95.

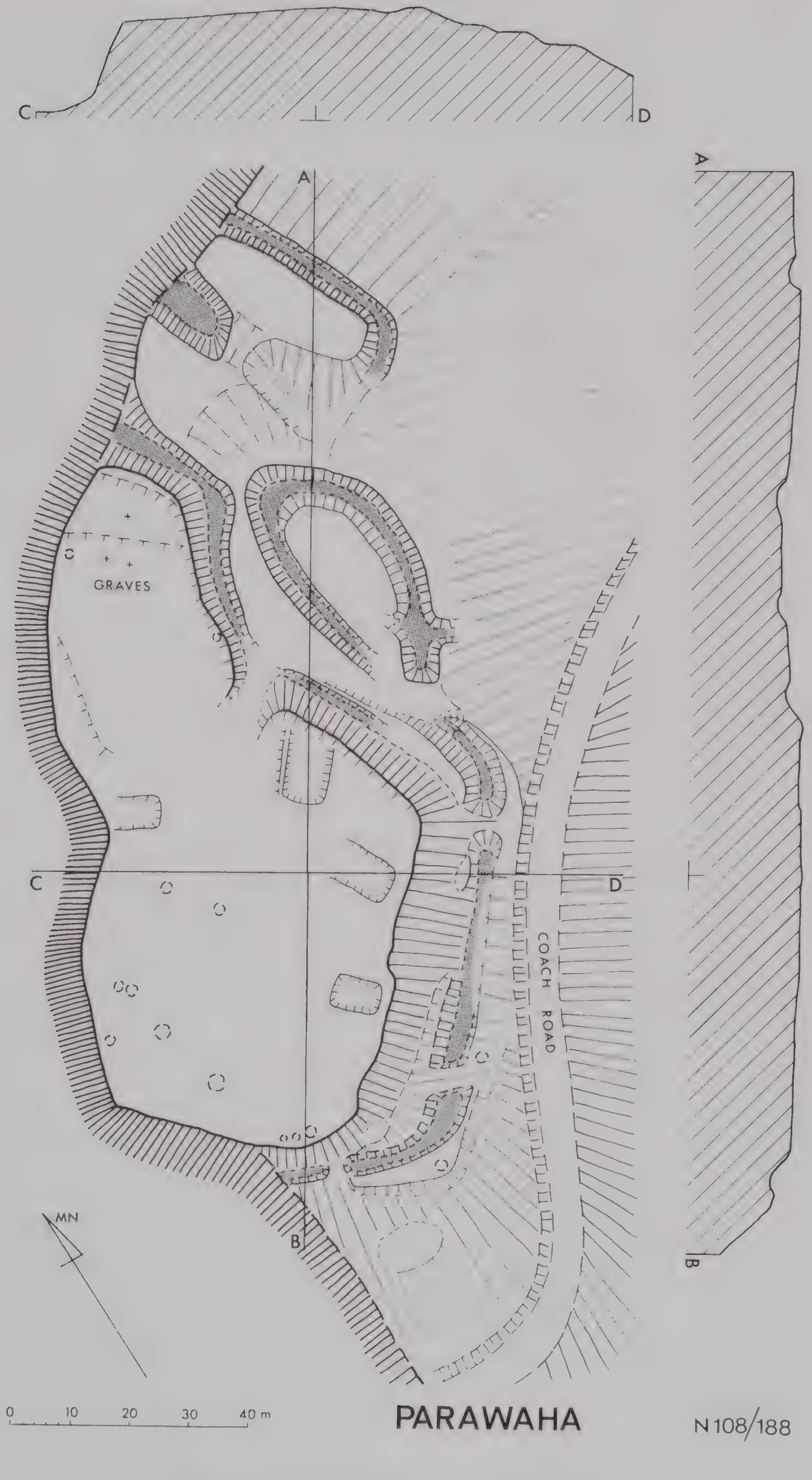

Fig. 16. Plan and sections of Parawaha (N108/188).

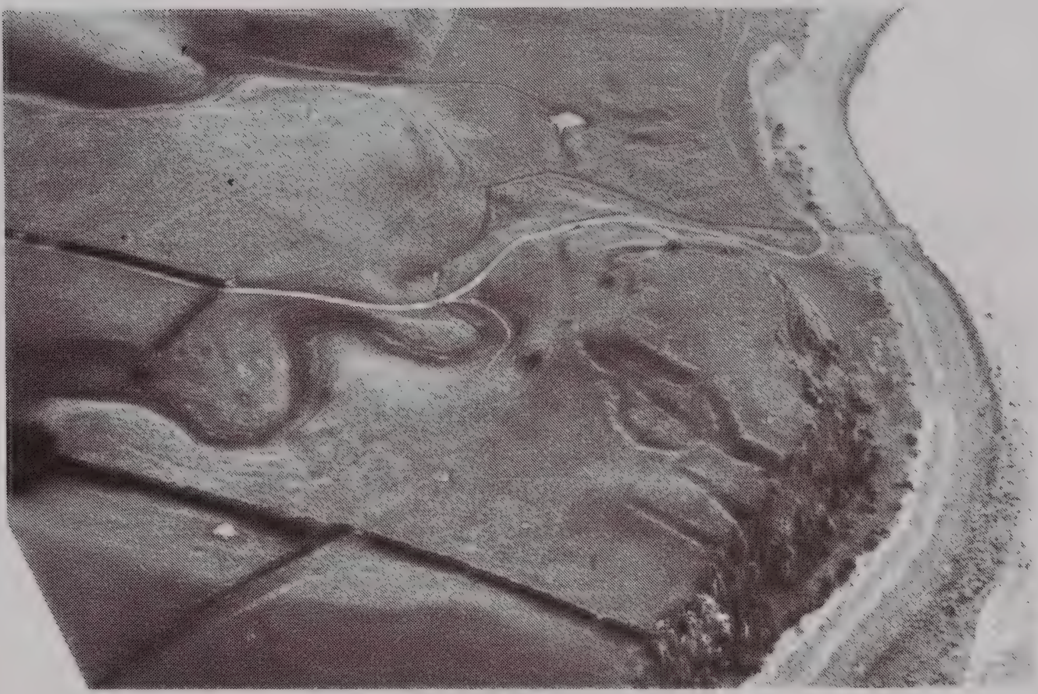

Fig. 17. Parawaha (N108/188) — aerial view from the north-east (1975).

Mangakino Stream. The old coastal road (the main route south from the New Plymouth settlement prior to the Taranaki campaigns of the early 1860s) skirts the pa as it descends to the sand flat and the Kaihihi River crossing. The site is now under grass and appears to be unmodified except for the nearby coach road.

Parawaha is strongly sited 15 m above the narrow valley of the adjacent Mangakino Stream to the south and 15 m above the sand flat behind the broad boulder beach to the north. The easiest approach is from the east where the main platform of the pa stands 5 m above extensive terrace country nearby. Artificial defences consist of a ditch and outer bank which extends around the southern and eastern sides of the pa 3-4 m below the platform rim. Additional ditches bar the vulnerable east end, including an unusual outwork set in front of the main entrance to the pa (see Fig. 16). Other ditches defend subsidiary platforms on the cliff top, again at the east end.

The pa is *ca.* 180 x 70 m overall. The main platform has maximum dimensions of 120 x 50 m. Several rectangular depressions on the platform probably represent houses, while ten *rua* over the western half and two near the eastern end represent perhaps a small part of the likely original food storage capacity. Three or four historic burials are situated at the east end. Below the platform rim at the west and south sides are three terraces and two possible *rua*. The total defended area of Parawaha, including the main platform (*ca.* 4000 m^2) and subsidiary platforms at the east end (*ca.* 1000 m^2), is *ca.* 5000 m^2.

Puketi N108/194 (477768) Fig. 18

Puketi is situated above the right bank of a tributary of Kaihihi River, 4.5 km from the sea. It commands a rising terrace, inland of Maitahi Stream and narrowing between the watersheds of Kaihihi River and the steep-sided Katikara River valley to the north. The site is now under grass with fruit trees planted on the platform. Massive pine and macrocarpa trees line the southern platform rim and defences. Remnant native bush including rewarewa, kohekohe, karaka, mamaku, rangiora and kawakawa is mainly in the ditch and bank on the north and west sides and in the gully to the south. Damage to Puketi includes a

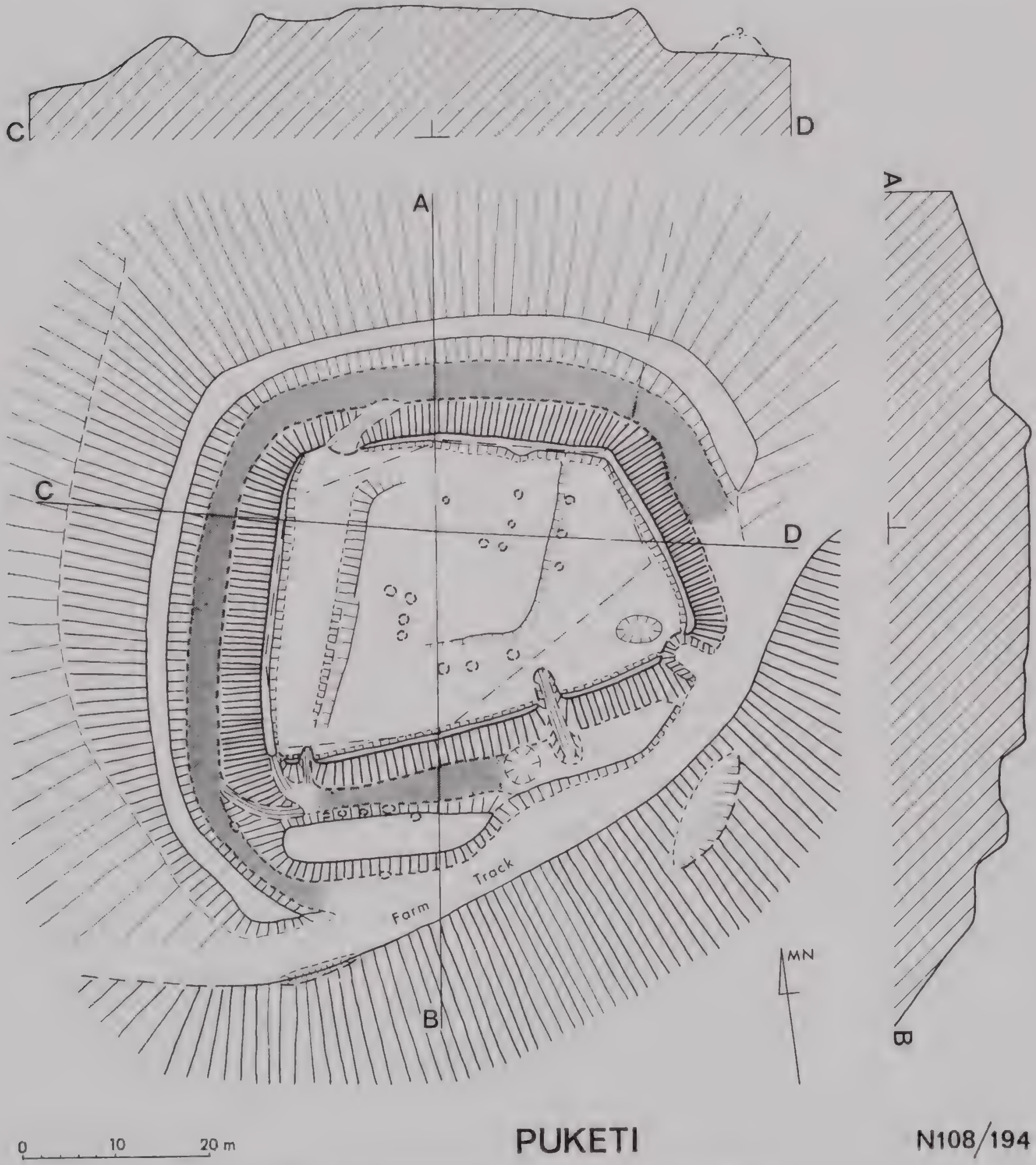

Fig. 18. Plan and sections of Puketi (N108/194).

farm road which has destroyed much of the defences on the south side, and a quarry dug into the south-east corner of the platform. The large trees are now helping break up scarps. Stock damage is severe in places.

Puketi is strongly sited on a spur of high ground which extends along the terrace edge to form a prominent knoll 8-10 m above the Perth Road terrace country to the west. To the south is a precipitous 25 m scarp into a now swampy gully. On the north-east side the natural advantage diminishes as adjacent ground rises towards the main road, while up the spur is a very slight saddle 100 m across to higher ground. Artificial defences consist of a single strong ditch and bank which now extends around the north and west sides of the pa and may have once continued right around where the farm road cuts the ground above the gully. Evidence for its presence above the gully includes a truncated section of bank beyond the farm track at the south-west corner and the remains of a ditch below the track at the south-east corner. Curiously, it is on the naturally strong south side that there is additional defence in the form of a second ditch, within, and 2-3 m above, the remains of the outer defences. The main (platform) scarp is 3-5 m high with the counterscarp 1-2 m where it survives. Virtually the entire circumference of the platform is topped by a well preserved bank, 0.3-1 m high.

The defended platform is divided into several areas by low scarps. Fifteen *rua* occupy four discrete areas. A large open pit at the south-east corner may represent a further one or more collapsed *rua*. Five more *rua* are dug into the counterscarp of the inner ditch on the south side or, in one case, is entered from the top of the broad bank nearby. Another *rua* may be represented by the open hole in the ditch nearby. Two further *rua* are dug into the foot of the main ditch scarp, again in the south-west corner. The total of visible *rua* is 22. The four-sided occupation platform is 33-46 x 21-32 m giving a defended area of *ca*. 1100 m^2 (excluding the use of defensive areas for storage).

N108/89 (471762) Figs. 19, 20

N108/89 is set above a lower tributary of Kaihihi River 1 km north of the Okato post office. It is a large and important fortification which has been very badly damaged in recent years. In the 1950 aerial photograph (1791/7; see Fig. 20) a single massive ditch can be seen curving around a clump of pine trees which at that time stood on the pa platform and defences. Further down the spur (north-west) is surviving native bush. In recent years the pines have been removed with extensive bulldozing virtually destroying the curving ditches and outer defences at the south-east end of the site. More bulldozing has caused great damage to the subsidiary platforms down the spur making these difficult to interpret. The site is now under grass and some gorse, with relict native vegetation at the margins and in the adjacent gullies.

This large pa is strongly located on a high point between two gullies. At both sides the gullies are 15 m or more deep with terrace country beyond dominated from the site. Below the major defended platform the site continues down the spur until the latter dips sharply to the gully fork. At the south-east end the platform is 4-5 m higher than the adjacent approach to the pa; higher ground is 120 m distant. Artificial defences include a ring-ditch encircling the upper platform with one or two additional transverse ditches cutting the spur at the vulnerable south-east end. (The outer of these is the curving ditch to be seen in the 1950 aerial photograph.) Surviving archaeological evidence suggests a deep

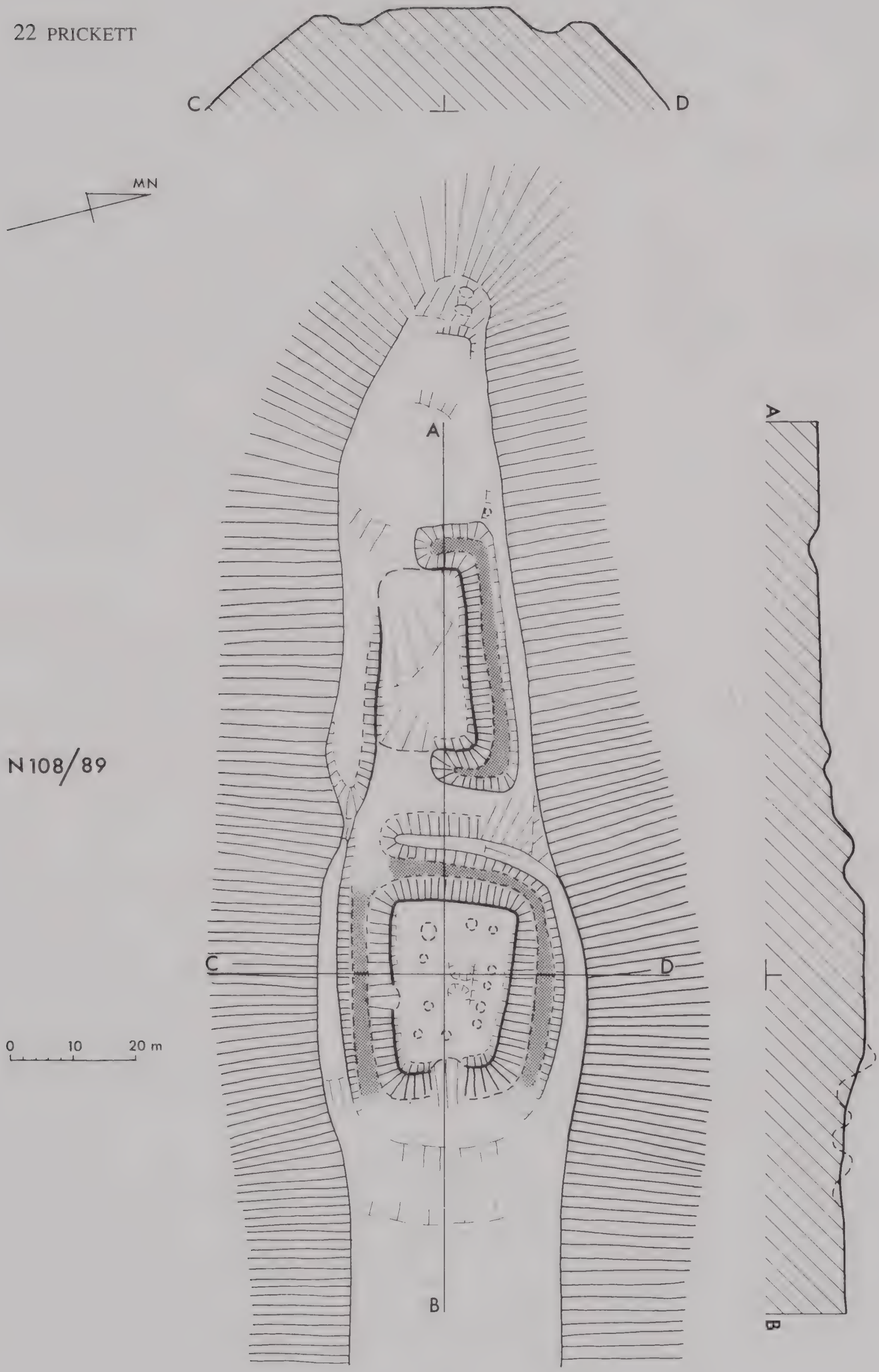

Fig. 19. Plan and sections of N108/89.

ditch and high encircling bank with the platform scarp 3.5-5 m in height. A slight bank tops the platform rim on three sides. North-west of the main ring-ditch defence is a lower second platform which may also have had ring-ditch defence although evidence for this now survives only at the north-east flank and adjacent ends, and to a degree only on the south-west side. A strong bank tops the platform rim along the intact north-east sector.

Eleven *rua* can still be seen on the upper platform of the pa. These are all similarly located 4-5 m in from the platform rim. The second platform, some 6.5-8 m below the chief defended area, now has no sign of food storage pits or other internal organisation. Outside this a further 40 m of spur contains badly damaged terrace and scarp defence with one *rua* and two small terraces surviving at the margins. This large pa was 130-140 m long and 30-45 m wide. The upper defended area is 25 x 16-20 m (*ca*. 425 m²). The lower defended area may have been 435 m² (29 x 14-16 m). Outside these defences at the north-west end of the spur is an occupied area possibly 400 m². Thus the total defended area may have been 860 m², and possibly in excess of 1250 m² if the inner end of the spur was also defended behind the ring-ditch which cut the spur and above the steep banks to the stream.

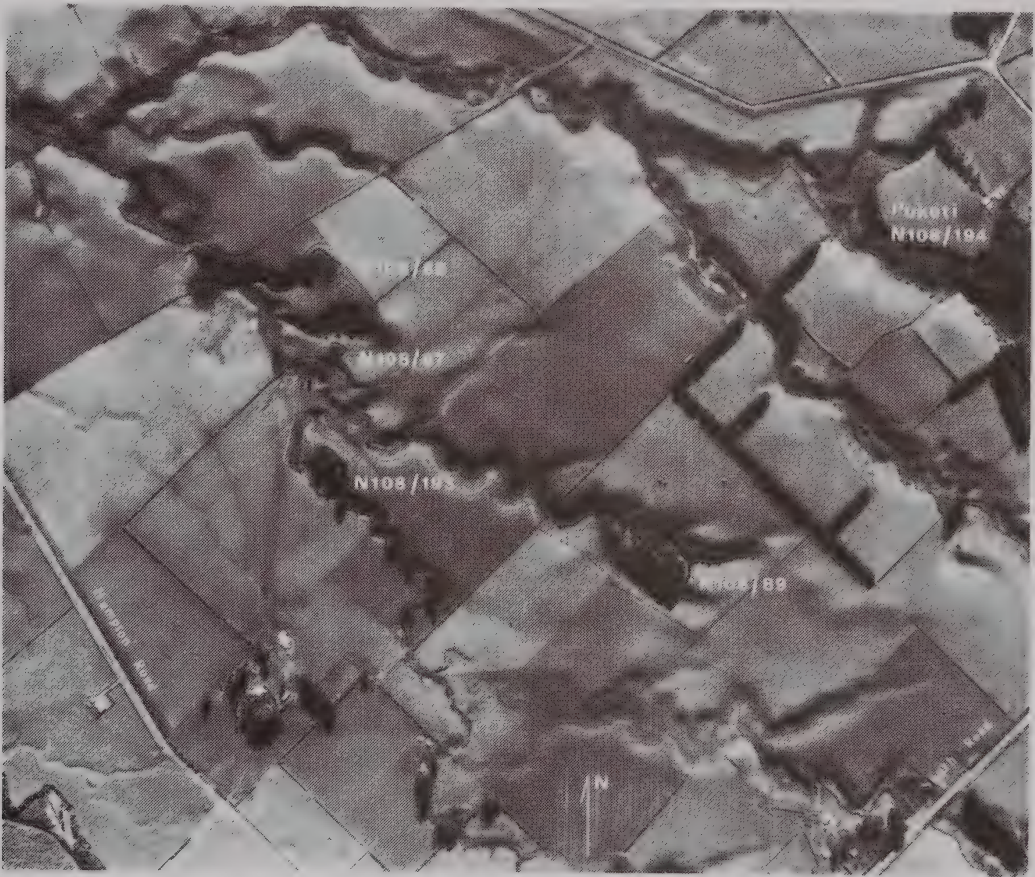

Fig. 20. Part of 1950 aerial photograph (1791/7) showing N108/87, 88, 89 and 193. Puketi (N108/194) is obscured under trees at extreme right.

Photo: N.Z. Aerial Mapping Ltd.

N108/193 (465764) Figs. 20, 21

N108/193 is inconspicuously located on a low spur end between two branches of a northern tributary of Kaihihi River. It is almost 4 km from the sea, in an area close to the deepening valleys and rising ridges which back the coastal terrace country of the Okato district. One hundred and fifty and 200 m northward are the fortifications N108/87 and 88, and 300 m eastward is N108/89. N108/193 is under pasture with massive pine trees on the platform and defences. Considerable erosion of platform scarps is apparent from the now aerial root systems of the pines, while some damage has resulted from preparation of a line for the present fence along the south-west side.

Natural defences of this site rely on a steep 10 m scarp into the gully south-west, and a less commanding but still useful fall into the adjacent lower ground to the north and north-east. The approach from the spur end is not difficult, while the site has only slight natural advantage over the ground up the broad spur to the south-east. The platform is indeed dominated by a higher terrace rim across the gully only 50 m to the south-west and, again, by the more distant but considerably higher ridge to the north-east on which N108/87 and 88 were situated. Artificial defence is of ring-ditch form. There is an additional transverse ditch at both ends and a second incomplete ditch at the north-west end. The unusual aspect of the lateral ditch apparently extending into two transverse ditches at both ends may be the misleading result of recent bulldozer work. The main platform scarp is still 2-2.5 m high, with counterscarps when apparent, 1-1.5 m. It is curious that the present evidence for a bank on the platform rim is at the stronger down-spur end where despite erosion it still stands 80 cm above the adjacent platform.

On the platform are seven large open holes which probably represent collapsed *rua* of the usual form. Behind the bank at the north-west end is a rectangular depression *ca.* 5 x 6 m in size. The site covers an area *ca.* 80 x 35 m; the defended platform, however, is only 36 x 14-16 m (*ca.* 550 m^2). Access appears to have been from the west corner (down-spur end) and on to the platform just within the rim bank.

N108/87 (465766) Fig. 20

This site is located low on a spur which dips north-west to the right bank of a lower tributary of Kaihihi River. Immediately over the gully to the north is N108/88; 150 m south is N108/193. N108/87 shows up clearly on the 1950 aerial photograph (1791/7; see Fig. 20), but was virtually destroyed in the early 1960s along with the two nearby ring-ditch works which are recorded together as N108/88. The site is now under grass with a macrocarpa plantation extending down the western side.

N108/87 is in two parts. The higher consisted of a simple ring-ditch fortification which stood on a slight knoll on the spur, giving good command over the gullies north-east and south-west and over the steeply falling spur north-west. It has almost no advantage over rising ground south-east up the spur and is completely dominated from the adjacent fortifications (N108/88) over the gully to the north which are 15 m higher and only 60-100 m distant. It seems likely that the ring-ditch work at N108/87 was indefensible on its own and that it and N108/88 make up a single contemporary defensible complex.

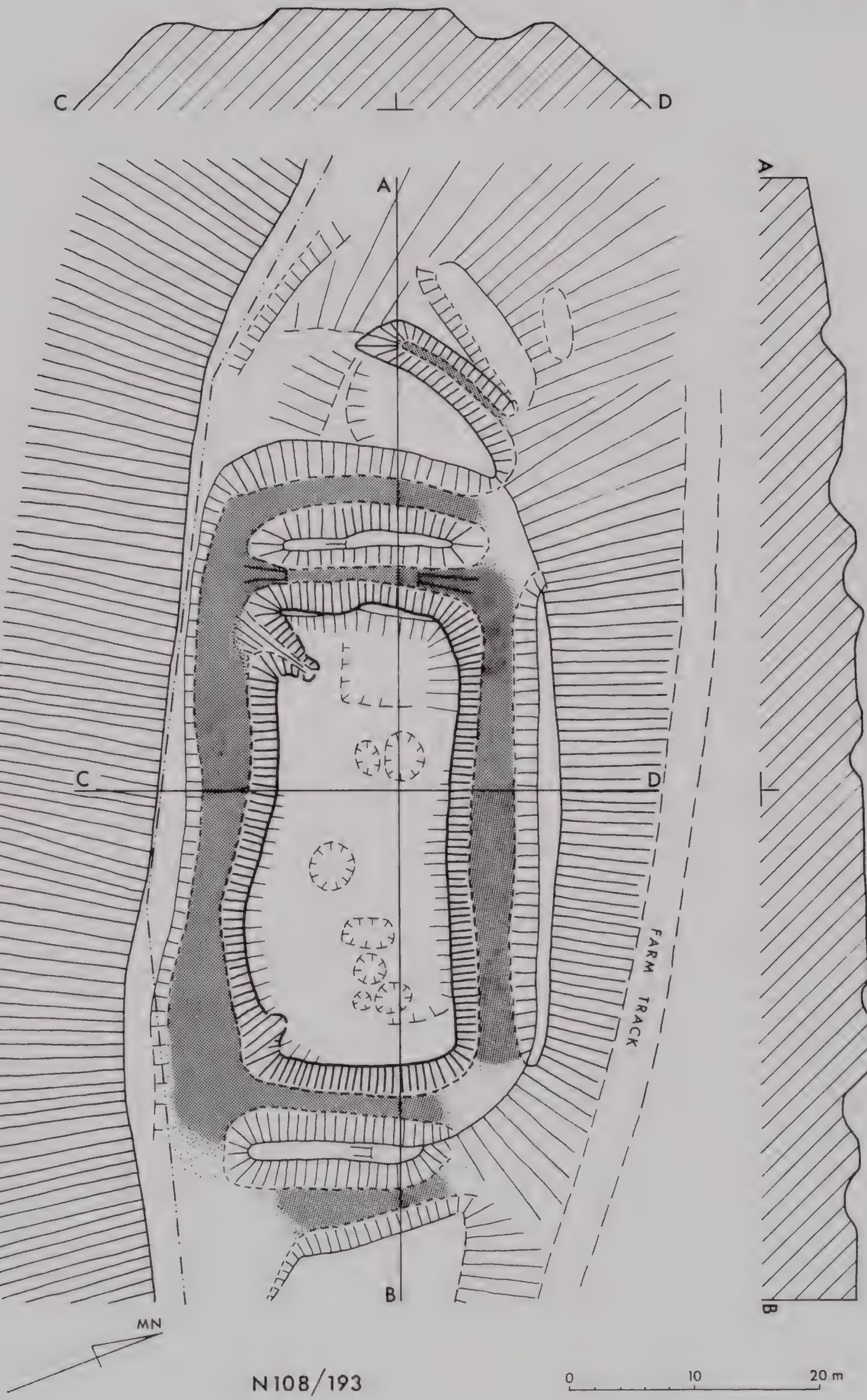

Fig. 21, Plan and sections of N108/193.

The ring-ditch earthwork can now barely be made out on the ground where a slight dip along three sides indicates a ditch *ca.* 25 m long and 15 m across the spur. The platform area may have been 200 m^2. Forty metres down the spur is a knoll *ca.* 25 x 10 m on which are some difficult terraces and four (perhaps six) *rua*. This part of the site appears to have been undefended.

N108/88 (465767) Fig. 20

Two ring-ditch earthworks, recorded together as N108/88, formerly occupied a knoll on the right bank of a lower tributary of Kaihihi River from which they commanded the adjacent gullies and terrace country. The smaller southerly fortification dominated nearby N108/87 on the low spur to the south. N108/88 can be seen in excellent condition in the 1950 aerial photograph (1791/7; see Fig. 20); it was completely destroyed by bulldozer work in the early 1960s. The area is now under grass.

N108/88 occupied a commanding knoll some 5-8 m above terrace country to the north and east, and 20 m above the gully to the west. Between them the two earthworks covered all approaches. The 1950 aerial photograph shows the larger northerly work to be four-sided with an encircling ditch and bank. An outer ditch curves around the north end of the fortification. The smaller southerly ring-ditch fortification was *ca.* 1.5 m higher than the other. It is also four-sided, with a shallow ditch extending from the neighbouring work, across the 20 m gap between them, and around its eastern and southern sides. This connecting ditch gives control over the intervening ground and is proof of contemporaneity.

From the 1950 aerial photograph it is possible to establish the size of the two earthworks. The larger defends an occupation platform *ca.* 35 x 15-20 m (580 m^2), and the smaller, a platform *ca.* 12 x 10 m (120 m^2). Not including the area between, which was at least partially defended, the combined defended area of the two ring-ditch works was *ca.* 700 m^2.

N108/190 (456774) Fig. 22

This small pa was situated on the right bank of a lower tributary of Kaihihi River, 200 m east of Hampton Road. Six hundred metres north-west are N108/91 and 92. N108/190 can be seen under gorse and other vegetation in the 1950 aerial photograph (1791/5). It has since been virtually destroyed. All that remains is the faintest suggestion of a transverse ditch 28 m from the spur end. The area is now under pasture.

N108/190 occupied the end of a short spur which extends westward to the stream from higher terrace country. Natural defences include an abrupt 8 m scarp to the stream and steep slopes into gullies north and south. To the east there appears to have been no natural advantage over ground which rises to command the fortification from only 50 m outside the defences. Artificial works can be made out from the 1950 aerial photograph. A ring-ditch provided the main defence, while an additional transverse ditch appears to have cut the spur at the vulnerable east side. The small square platform was perhaps 18 x 15 m (*ca.* 250 m^2).

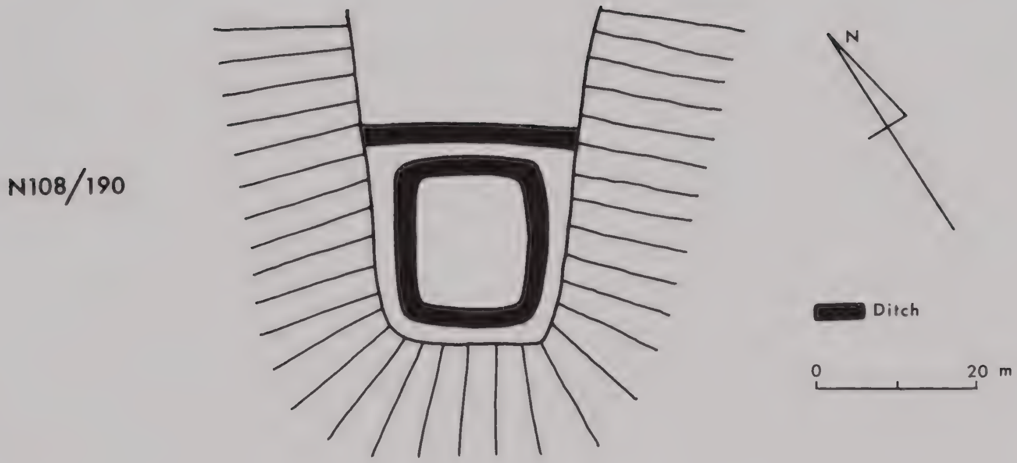

Fig. 22. Reconstruction of defences of N108/190.

N108/91 (452776) Fig. 23

Two small fortifications stand 50 m apart on opposite sides of a northern tributary of Kaihihi River. From their similarity and proximity it seems likely N108/91 and 92 are contemporary. N108/91 is now under grass with gorse on the flanks and remnant native bush in the gully to the south. The site has suffered from the making of farm access across the ditch and bank defences at the south-east corner and probably as well from a general smoothing of the platform.

Natural defences of this site are slight. There is a useful scarp 8 m into the gully on the south side and an easy 5m scarp into the rising gully head on the north side. The approach up the spur is not difficult, while the rising spur allows no natural advantage over an approach from the south-east. Artificial defences do not seem adequate to the task. A single ditch and bank extends around the site, except down the south side and where broken by a causeway at the north-west corner. The ditch is 1-2.5 m below the platform, with the counterscarp nowhere more than 1.7 m.

The occupation platform has evidence of nineteen *rua;* another is set in the causeway across the ditch. *Rua* are concentrated near the southern scarp to the gully and along the northern and eastern margins, thus leaving much of the platform centre free for above ground buildings. The main platform is 40 x 16-21 m, below which, at the north-west end, there is a small terrace. This gives a total defended area of *ca.* 800 m^2.

N108/92 (451776) Fig. 24

N108/92 is 50 m west of N108/91 on the opposite bank of a northern tributary of the Kaihihi River. It is now under grass and has suffered some damage at both ends, apparently in the preparation of farm access along the spur.

Natural defences are not strong. N108/92 stands 8 m above lower ground on both sides but it has only a very slight advantage over the flat topped spur north and south. A

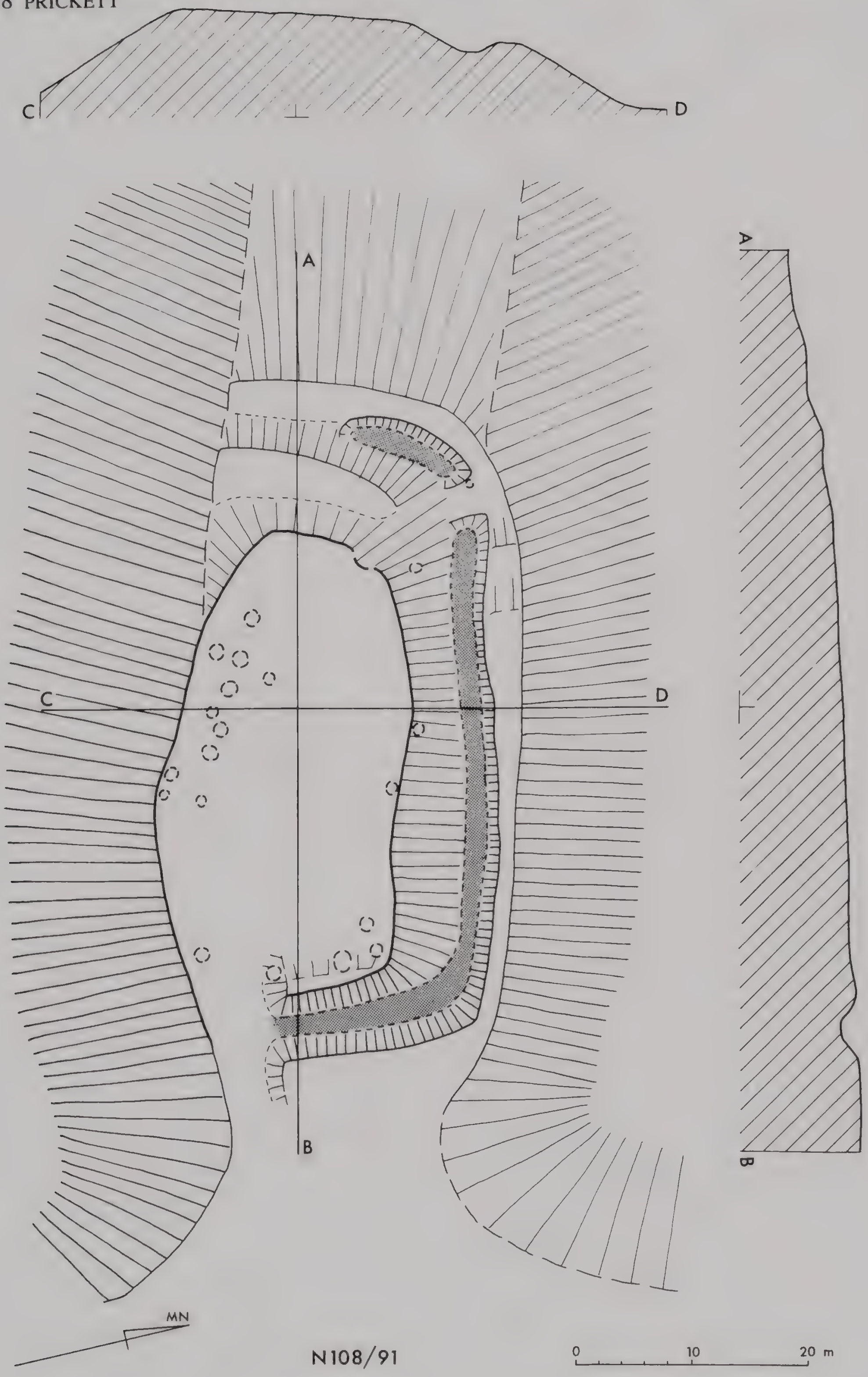

Fig. 23. Plan and sections of N108/91.

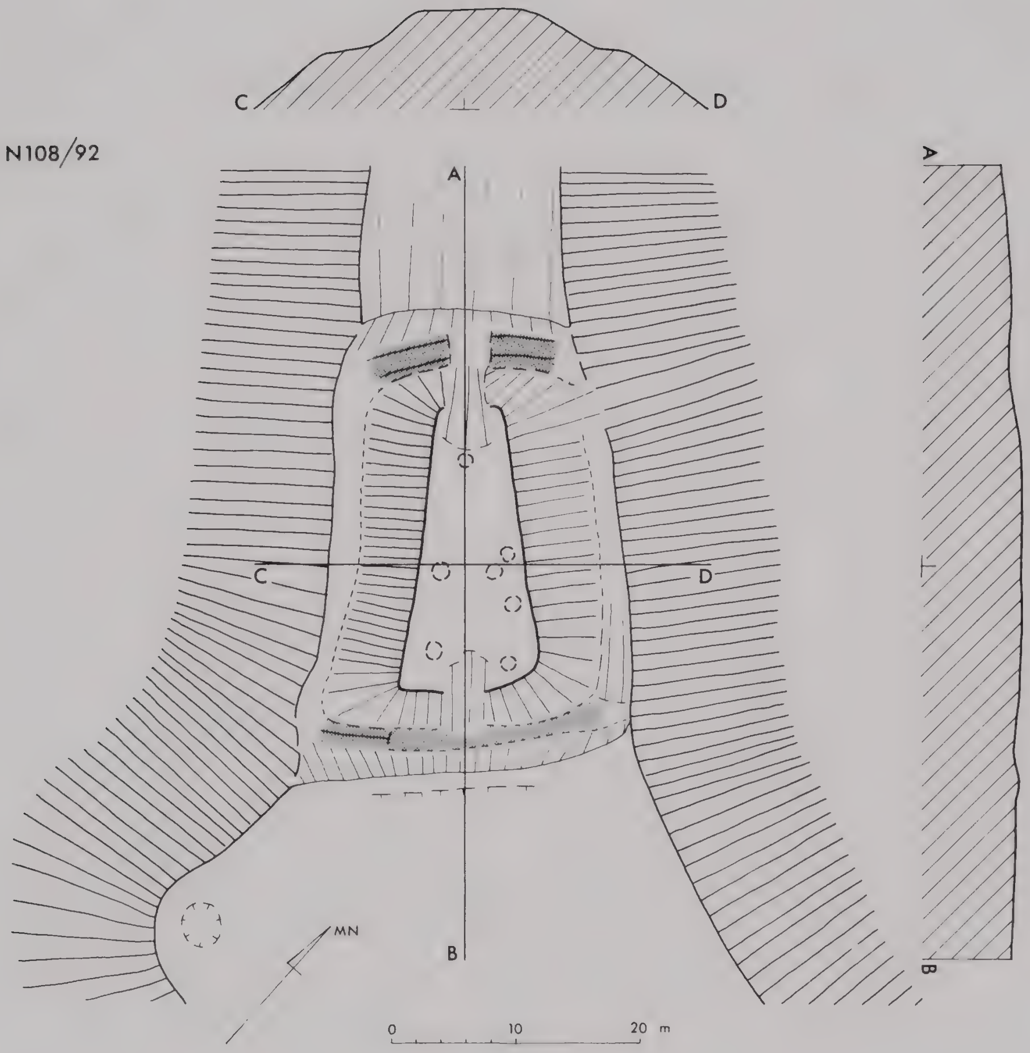

Fig. 24. Plan and sections of N108/92.

single, now shallow, ditch cuts the spur at both ends of the site, with terraces down both sides possibly representing ditches but more likely to be the remains of terrace and scarp defence.

On the single small platform is evidence of seven *rua*. The platform is 23 x 6-11 m, giving an area of *ca*. 180m².

Potahi N108/84 (464750) Fig. 25

Potahi is located within the present Okato Domain on a lahar mound truncated by the terrace edge above the left bank of the old Kaihihi river bed (the river is now some 50 m away in the narrow flood plain). The name comes from the Rigby Allen place names index in the Taranaki Museum. The site is now in good condition under secondary bush dominated by karaka and kohekohe, with kawakawa and hangehange understorey. Some large gum trees are present on the platform and elsewhere. Three hundred metres northward is the remains of Pukekuri (N108/192), similarly sited on a truncated lahar on the terrace edge.

The defences of this small pa are unusually strong. To the rear (north-east) is a 15 m cliff to the old river bed. Elsewhere the levelled top of the mound stands 5 m above the adjacent terrace. The natural advantage is reinforced by a strong double ditch and bank, the outer of which does not quite extend to the cliff at the north-west end. Even now the main defensive scarps are 2-2.5 m high at the south-west side and 1.5 m high at the ends, with the counterscarps 0.5-1 m high.

Evidence remains for six *rua* on the platform, with a large open pit perhaps representing a seventh, now collapsed. The single, level, platform is 24 x 8-12 m in size, giving an area of *ca.* 200 m^2.

Pukekuri N108/192 (463753)

Pukekuri was situated within the present township of Okato on a lahar mound at the terrace edge above the Kaihihi River flood plain. It is 300 m from Potahi on the opposite bank of the river. Pukekuri can be seen in the 1950 aerial photograph (1791/7) where quarrying has already begun at the south side of the mound. The pa has since been virtually destroyed by quarrying, the preparation of an adjacent house site and other activity. The name is established from the Okato sheet of the Town Plan series map (Lands and Survey Department, New Plymouth).

The 1950 aerial photograph shows a flat topped mound strongly defended on the north-east side by a scarp and an outer ditch close under the mound. Present topography suggests the platform scarp was 5-6 m high. The 10-12 m high cliff to the river flat at the rear of the site needed no artificial defences.

Again using the 1950 aerial photograph, the single level occupation platform of Pukekuri appears to have been *ca.* 30 x 15 m, perhaps 400 m^2. There may have been some *rua* along the platform margin above the river flat.

N108/181 (445774)

A single ditch and bank defence formerly cut off a triangular piece of ground on the terrace edge above the left bank of Kaihihi River a little more than 2 km from the sea. The simple form of defence is markedly similar to that of N108/94, on the right bank of the river 1 km downstream. The defences of N108/181 are clearly visible in aerial photograph 1791/5 taken in May 1950. Since then, however, the ditch and bank, and presumably much of the defended area as well, have virtually been destroyed in bringing this part of the paddock under cultivation. The remains of the ditch can be seen at both ends where it meets the steep scarp to the river valley and, rarely, as a slight depression as it crosses the terrace between. The site is now under grass with four large rewarewa and a karaka on the defended area and boxthorn and macrocarpa on the rear terrace edge.

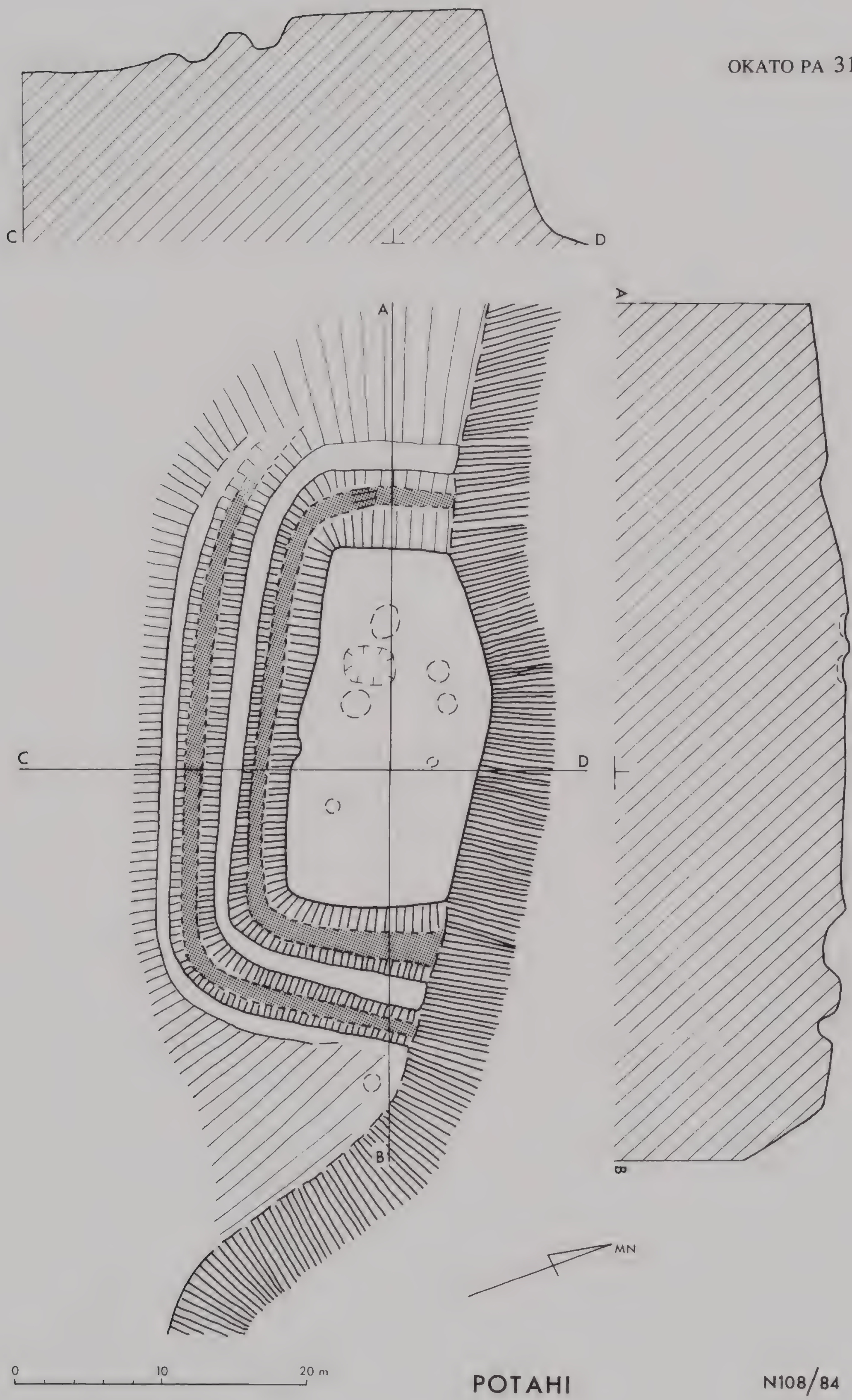

Fig. 25. Plan and sections of Potahi (N108/84).

The triangular defended area was protected at the rear by an 8-10 m scarp to the river valley and across the front by a single 75 m long ditch and bank. To judge from remaining evidence, the ditch may have been quite massive. Outside it the ground rises slightly to the west.

The defended area of N108/181 was approximately 1600 m^2. Within the defences broken ground suggests damaged occupation evidence — this having some confirmation from the 1950 aerial photograph which has indications of earthworks under scattered trees near the rear scarp.

N108/94 (443785) Fig. 26

This defensive earthwork is above the right bank of Kaihihi River, 1.3 km from its mouth. The site is now under grass, and except for the ditch, which is still in good condition, the whole area has been cultivated. Some remnant native trees survive in the gully to the east and north of the defended area. The ditch is highly visible in the 1950 aerial photograph (1790/3; see Fig. 26).

The single ditch extends from a steep-sided tributary gully, 8-10 m deep and 30 m wide, across a terrace to the abrupt 10-12 m scarp to the bed of the Kaihihi River. The ditch is now 66 m long but may originally have been slightly longer: the ponding area for a tunnel which cuts through the terrace to the Kaihihi River bank (to provide 'head' for a hydraulic pump) has destroyed some part of the east end of the ditch. What appears to be an extension to the ditch continues for *ca.* 25 m at right angles to the main transverse ditch above the stream at the east margin of the site. Where this met the main ditch is now destroyed by excavation for the ponding area. The ditch is 7.5 m from rim to rim, and as much as 2.25 m deep. The cut section at the east end of the ditch reveals 1.5 m depth of fill, indicating that the original depth of the ditch was *ca.* 3.5 m. A very slight rim survives on top of the inner ditch scarp.

The ditch cuts the terrace as it dips slightly to the north. Within the defended area, the terrace continues to fall *ca.* 3-4 m in the initial 40 m behind the ditch. Otherwise the defended area is virtually level. The defended area is roughly rectangular measuring *ca.* 80 x 200 m (16,000 m^2).

N108/137 (441788) Figs. 26, 27

The remains of N108/137 are situated on the left bank within a sharp bend of Kaihihi River, not quite 1 km from the sea. Immediately over the river to the north is the pa Orongomaihangi (N108/44) which was one of three pa on the Kaihihi River attacked by General Pratt and 1000 men in October 1860 (see Prickett 1981:68-72). Another of the Maori fortifications of 1860 is Mataiaio (N108/138), which was situated close to N108/137 (see Figs. 26, 27), with its escape ditch running south-east into the outer ditch of the earlier pa (and thence to the river valley). N108/137 can be seen in the 1950 aerial photograph (1790/3; see Fig. 26) still substantially intact although the outer ditch has been softened through cultivation. (Nearby Mataiaio, further out in the paddock, is already almost erased.) The greater part of the site is still intact under gorse and some trees. Since 1950 the two outer ditches have been filled in and most of the pa has come under the plough. The site is now under grass with dense bracken remaining on the innermost platforms and remnant native trees on the steep scarps to the river.

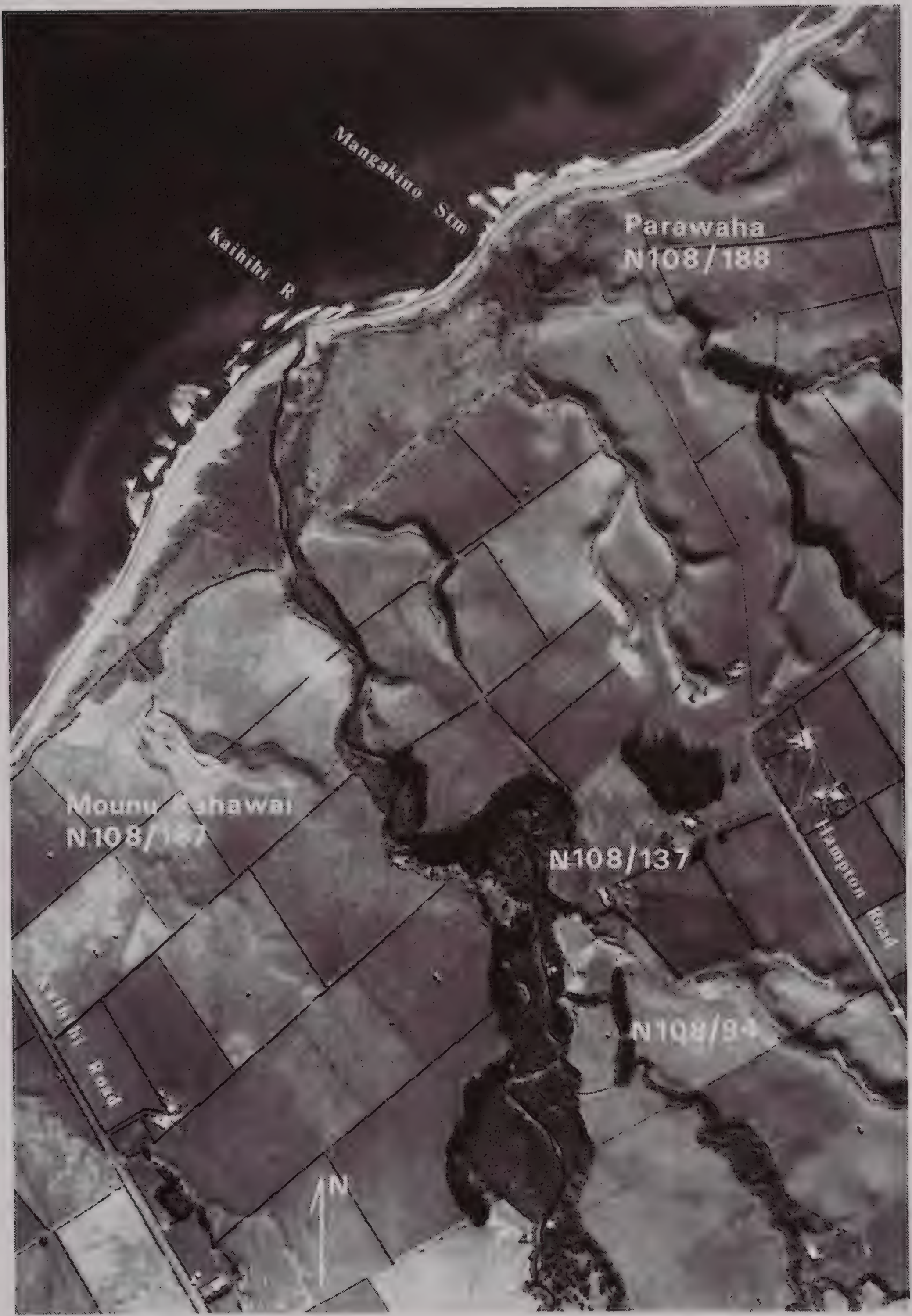

Fig. 26. Part of 1950 aerial photograph (1790/3) showing N108/94, N108/137 (with adjacent 1860 fortification Mataiaio, N108/138), Mounu Kahawai (N108/187) and Parawaha (N108/188).

Photo: NZ Aerial Mapping Ltd.

Natural defences consist of abrupt 12-15 m scarps to the bed of the Kaihihi River on the east and north-west sides of the triangular defended area. The easy approach from the extensive terrace to the west was barred by a series of ditches. The two outer ditches are now filled in but in both cases can be seen at their ends where they meet the scarp: they are respectively 100 m and 80 m long. A third ditch cuts the narrowing terrace 50 m from the second ditch, while a further two ditches cut the narrow point beyond the main inner platform. From present evidence the ditches appear to have been exceptionally wide (10-12 m) and deep. The remains of rim banks can be seen above surviving parts of the second and third ditches. Some use appears to have been made of water-rolled boulders from the nearby riverbed for revetting of scarps of which two small examples remain.

The defended area of N108/137 extends for *ca.* 200 m from the outer ditch to the point of defended land at the northern end of the site. At its widest the outer platform is 80 m across. The total defended area is *ca.* 10,000 m^2. This area includes five separate platforms which give an area excluding ditches of 5500-6000 m^2. Eight *rua* survive on the inner 800 m^2 platform, including five grouped together below a slight scarp at the north-east end. One other *rua* remains on the 3200 m^2 second platform.

Mounu Kahawai N108/187 (435792) Fig. 26

This historic pa occupies a position on the terrace above the left bank of the Kaihihi River mouth in much the same situation as N108/163 at the mouth of Katikara River. One kilometre north-west is the important fortification of Parawaha. In about 1818 Mounu Kahawai was taken by the raiding party known by the name of Murupaenga, the fighting chief of the Ngati Whatua of Kaipara (Smith 1910:283-292). Other tribes involved were the Ngapuhi, Ngati Toa, Ngati Tama and some sections of the Te Atiawa. Having taken Tataraimaka, 5 km north-east, the *taua* moved on to Mounu Kahawai. Smith (1910:288) quoted W.H. Skinner in his account of what happened. Mounu Kahawai "was of great size, with a large population, but was not a strong position, being built on comparatively flat ground. The invaders fired the dry raupo growing in the swamps (named Totoaro) around the *pa*, and under cover of the smoke and consequent confusion stormed the place with great slaughter." The raupo swamp was presumably in the gully of the Matanarara Stream, the eastern tributary of which skirts the pa. The site is now under grass having been cultivated many times. The remains of defensive works can be made out along the west and south sides.

As Skinner noted, and Murupaenga's *taua* turned to advantage, Mounu Kahawai occupies a position of little natural advantage. The extensive terrace taken up by the pa is *ca.* 15 m above the adjacent Kaihihi River and Matanarara Stream valleys and the sea beach to the north. The useful terrace scarps to river and sea beach do not compensate for the easy approaches elsewhere. Artificial defence can be made out on the 1950 aerial photograph (1790/3; see Fig. 26) and on the ground. Across the easy slope to the west there appears to have been a single massive ditch and bank 200 m in length, extending quite straight from the sea cliff south to the valley of Matanarara Stream. This defensive line then continues around the escarpment 4-5 m below the terrace edge for a total length of *ca.* 300 m before cutting 40 m across to the cliff to the Kaihihi River, and thus barring the easiest approach to the pa from nearby terrace country to the south-east.

No sign of internal organisation can be found on the now cultivated interior of Mounu Kahawai. The defended area may have been as much as 55,000 m^2.

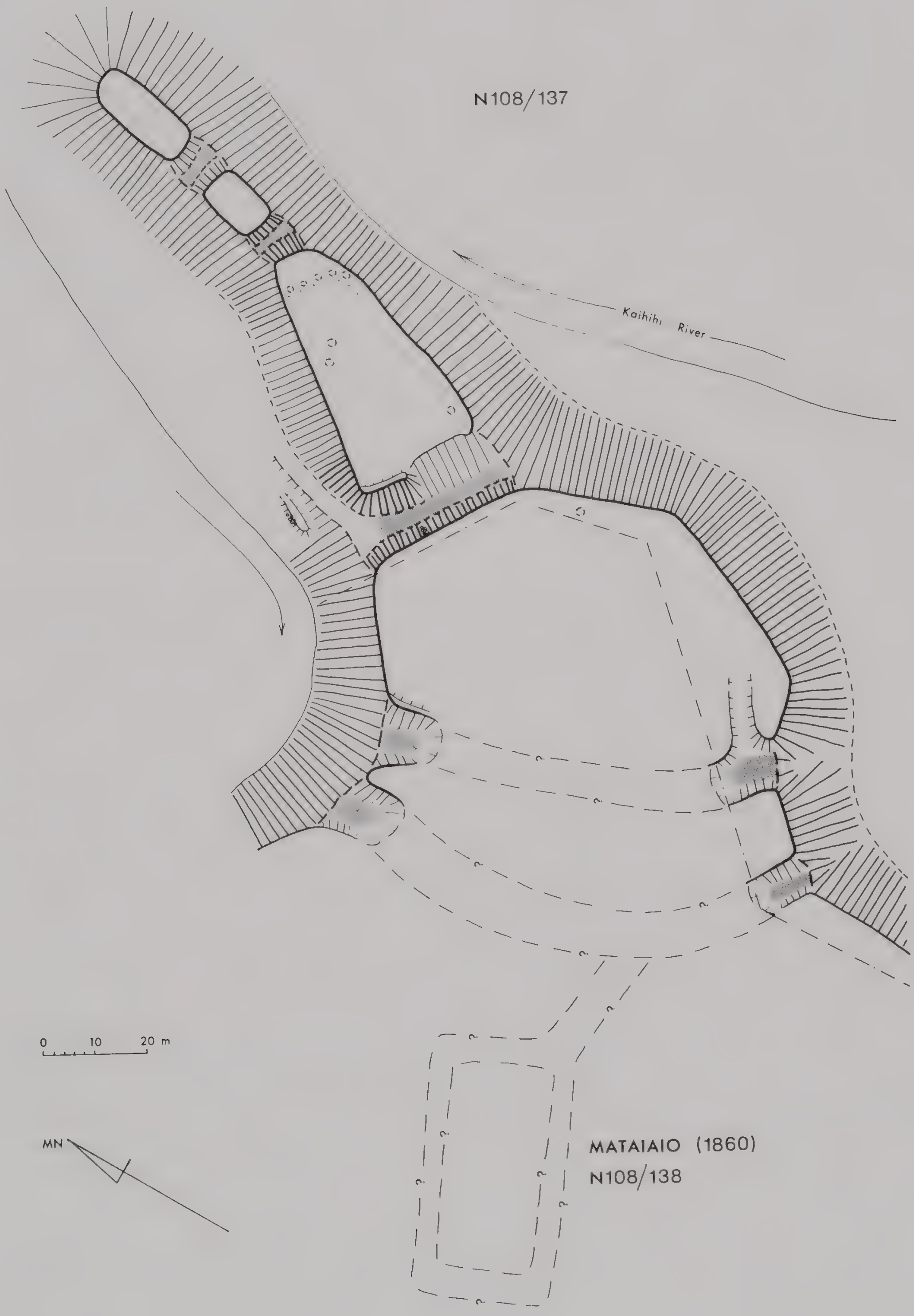

Fig. 27. Plan of N108/137.

N108/186 (422777)

A single massive ditch cuts off an area of terrace against the sea cliff on the left bank of Horomanga Stream. The site occupies a surprisingly commanding situation which gives good views over lower ground to Stoney River and beyond, as well as over the beach and sea below and the terrace country east. Five hundred metres south is N108/185, while 900 m north-east is the site of the historic Nga Mahanga *kainga* Whareatea (N108/93), also situated on the cliff edge above the beach. N108/186 has been ploughed many times and is now under grass. Surviving archaeological evidence includes the remains of the ditch, some dimples indicating *rua*, and charcoal and shell eroding from the terrace rim above the beach.

Natural defences include the steep 20 m scarp to the low flat behind the beach, and the gully of Horomanga Stream to the east. Artificial defences consist of a ditch and bank — now 8 m from the top of the inner bank to the counterscarp rim — which extends for *ca.* 250 m from the sea cliff to curve around towards the Horomanga Stream. These defences have been destroyed at the east end by the old coast road which crosses the gully at this point. The road continues across the defended area and cuts the defences again at the west end of the site.

There is no sign now of internal organisation within the defended area except for dimples indicating *rua* which seem to concentrate at the west end. The present landowner states that when the land was first ploughed the horses fell into many 'holes'. N108/186 is 200 x 80 m, giving a defended area of *ca.* 16,000 m^2.

N108/185 (420773)

N108/185 occupies an isolated lahar mound on the edge of terrace country overlooking the flood plain of the lower Stoney River. It also commands a useful view north to N108/186, 500 m away. The defensive ditch which cut the north side of the site was ploughed in during the 1940s and can be seen only with difficulty. It is barely visible in the 1950 aerial photograph (1791/3). The site is under grass.

Natural defences are strong. On the south side there is an abrupt 10-12 m scarp to the old flood plain. The top of the hill stands 5-6 m above the terrace to the north. The single (now destroyed) ditch cut the terrace behind the knoll.

Five or six terraces remain on the defended area which falls to the north. On a higher terrace there is a single *rua*. Spilling down the escarpment at the rear of the site is some fragmentary charcoal and shell. The defended area measures 40 x 20 m — *ca.* 500 m^2, although actual living space on the several small terraces is a good deal less than this.

DISCUSSION

Of the 27 fortifications recorded in the Okato district, eleven are of ring-ditch form. Another five make use of a scarp or cliff at one side with the other three sides defended by one or more ditch and bank. Other forms employ straight or angled ditches cutting off headlands or other sections of terrace country, on occasions making use of steep stream gullies which extend at right angles to the primary sea or river scarp. A fourth group has transverse ditches cutting spurs, with terrace and scarp or simple scarp defence down the sides. Many sites, particularly those of ring-ditch form, take advantage of naturally defensible hills or mounds. At the south of the survey area three such mounds are volcanic in origin and are now cut by the narrow flood plains of Kaihihi (Potahi and Pukekuri) and Stoney Rivers (N108/185) respectively.

Ring-ditch pa mostly defend a single small platform. Simple ring-ditch defence, without additional transverse or other ditches, occurs at N108/87 (Fig. 20), N108/96 (Figs. 11, 13), N108/97 (Figs. 10, 11), N108/195 (Fig. 2) and probably N108/104 (Fig. 5) as well. Ring-ditch defence with additional transverse or other works is to be found at Pukekohe (Fig. 4), N108/190 (Fig. 22) and Puketi (Fig. 18), all of which have a second ditch covering a section of the approach. N108/193 (Fig. 21) has an additional transverse ditch at both ends, with a partial second outer ditch covering the more difficult approach up the spur. The remaining two ring-ditch works are more complex: each defends two platforms, with additional ditches either linking the separate ring-ditch defences (N108/88), or barring the easiest approach from nearby higher ground (N108/89; Fig. 19).

There is a varied group of pa which are sited to make use of a cliff or scarp on one side. Three of them (Potahi (Fig. 25), Pukekuri and N108/185) occupy lahar mounds on the edge of terrace country cut by low cliffs to river flood plains. These have had their natural advantage supplemented by one or two ditches which extend from scarp to scarp around the more vulnerable terrace side. N108/160 (Fig. 7) is a simple rectangular defence backed up against a steep scarp to the Katikara River; its form and situation suggest a mid-nineteenth century gunfighter position. N108/91 (Fig. 23) is a similar simple work making use of a scarp on one side, although in this case its situation and numerous *rua* mark it as a pre-European work. Parawaha (Figs. 16 and 17) is defended by sections of simple and complex ditch and bank earthworks on the landward side.

In addition to the partial ring-ditch works is a group of pa which employ ditch and bank defences to cut off what are frequently extensive areas of terrace. The artificial defences of these fortifications extend from what might be grouped with the partial ring-ditch pa, described above, to simple straight ditches which bar the approach to a headland. Among the former is Mounu Kahawai (Fig. 26) which relies on a single long ditch and bank, which makes some use of natural features as it works its way around a very extensive section of terrace on the south bank of the Kaihihi River mouth. Also on the coastal scarp between Stoney and Kaihihi Rivers is N108/186 which has a 250 m ditch and bank curving around two sides of an area which is otherwise defended by the seaward scarp and the steep-sided gully of Horomanga Stream. N108/94 (Fig. 26), N108/181 and N108/191 are defended by single slightly curved ditch and bank defences which cut across a terrace to isolate a piece of ground protected elsewhere by natural scarps to river bed or stream gully. N108/163 (Fig. 9) appears to have been defended by two ditches and banks.

The fourth group is of sites which employ transverse ditches to cut spurs and terrace and scarp defence along the flanks. N108/92 (Fig. 24) and N108/95 (Fig. 15) are small, simple fortifications in which transverse ditches serve to cut off a narrow section of an extensive terrace. N108/92 has terrace and scarp on one side and simple scarp defence on the other. The other two sites, N108/101 (Fig. 8) and N108/137 (Fig. 27), are more complex. They have four or five transverse ditches which cut a spur into several defensible platforms. N108/101 has simple scarp defence on the sides and at the down-spur end, while N108/137 again makes use of natural scarp defence on the flanks.

Pa of the Okato district vary greatly in size. At one end of the scale is Mounu Kahawai which defended an area estimated at 55,000 m^2, and at the other are N108/92, 104 and 160 of defended areas of only 180 m^2. Mounu Kahawai is much the largest pa of the entire survey region (New Plymouth to Stoney River). It is, however, only the outstanding example of a group of sites in the Okato district which employ similar defensive arrangements and which are all among the largest sites of the region — these are N108/163 (defending 10,000 m^2), N108/94 (16,000 m^2) and N108/186 (16,000 m^2). In size they can be compared only with Kekeorangi (16,000 m^2), a pa of similar form on the coastal cliff north of Oakura (Prickett 1980:28-30).

Within the Okato pa presented here there is sometimes useful evidence of internal organisation. N108/97 (Fig. 10) has its sloping platform divided into several terraces on most of which are *rua* for food storage with platforms for dwellings nearby. The uppermost platform, the *tihi*, has four *rua* tucked behind it adjacent to the defensive bank. Puketi (Fig. 18) has *rua* scattered throughout the platform and in places within the ditches. Other sites have their storage capacity at the platform margins (N108/91, Fig. 23), or the centre (N108/95, Fig. 15; and N108/193, Fig. 21). The surviving platform of N108/89 (Fig. 19) has *rua* regularly placed near the platform rim. At other sites *rua* often show some evidence of grouping within the platform area (as, for example, N108/92, Fig. 24; and Potahi, Fig. 25). Parawaha (Fig. 16) has evidence of both *rua* and house platforms. The largest sites of the district have, because of their terrace situation, suffered greatly from cultivation over the years — it is difficult in these cases to say anything about internal arrangements.

Pa of the present survey area occupy a variety of topographic situations. Some make use of hilltops to give command over surrounding countryside. Pukekohe (see Fig. 3) is the best example of these; others are N108/88, N108/96 and, to an extent, Puketi as well. Mostly, however, it is the immediate topographic advantage which is important and not the more distant view. Hence, most sites occupy situations which allow some natural defence or advantage even if higher ground is close at hand. Thus the strongly defended N108/193 is overlooked by nearby higher ground across gullies on both flanks. Similarly, N108/95 and N108/190 are examples of positions which have only a restricted view of the surrounding area. N108/87 on the other hand, and probably N108/97 as well, although possessing little command themselves over surrounding countryside, were probably occupied in conjunction with the nearby hilltop sites of N108/88 and N108/96 respectively.

Mention has already been made of the small group of very large sites which occupy vulnerable terrace edge situations. The similar scale of these fortifications, their like situations and their comparatively weak defences suggest a degree of contemporaneity and some similarity of function. If the sizes of pa are taken as some indication of population numbers then these large sites gave protection to considerable numbers of people. In the case of Mounu Kahawai the perimeter of 800-1000 m would have required a large number of fighting men to effectively man the defences. It may on the other hand be argued that the fact that Mounu Kahawai was taken demonstrates that the number of defenders was insufficient for the task.

The types of fortification employed about the lower Kaihihi and Hangatahua Rivers illustrates nicely the degree to which landform relates to pa form. Beyond the numerous gully edge situations and rounded hills of most of the surveyed region, the lower terrace country and occasional lahar of the Pungarehu and Warea Formations offer a limited range of naturally advantageous positions. Hence, in the changed landscape south and west of Kaihihi River are only the large terrace edge pa with their simple linear defensive works and the three sites which occupy lahar backed against abrupt scarps to narrow flood plains. South of Stoney River the landscape is substantially the same although many more lahar lend themselves to a great many fortifications mostly of ring-ditch form which make use of these natural situations. As far as Warea this land too belonged to the Nga Mahanga people. The present study, however, depends for its coherence on the uniformity of landscape forms, regional geographic situation and the essential continuity of historical occupation. The Kaihihi-Hangatahua River landscape is a foretaste of a markedly different archaeological landscape to the south which awaits description at some future date.

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AN ARCHAEOLOGICAL RECONNAISSANCE OF THE SHORE WHALING INDUSTRY ON KAPITI ISLAND, NEW ZEALAND

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Abstract. The whaling industry played an important part in early nineteenth century contact between Maori and Pakeha in New Zealand. Shore whaling is open to archaeological investigation, to define material and other aspects of the industry itself and to examine the nature of the relationship between whaler and Maori. There were perhaps eight whaling stations on Kapiti Island and its nearby islets. Together they make up what may be the outstanding surviving archaeological landscape of New Zealand's shore whaling industry.

Whaling in New Zealand waters began in the late eighteenth century. The first record of a visit by a whaling vessel is that of the *William and Ann* which was at Doubtless Bay in 1792 (Morton 1982:125). At first the industry was based upon offshore (or pelagic) whaling, for the sperm whale or cachalot *(Physeter catadon).* By the early nineteenth century whalers were commonly using the Bay of Islands as a place to rest crews and take on supplies. In 1836 there were 151 visits to the bay by British, Australian, American and French whaling vessels (Wright 1967:30).

As early as the seventeenth century New England whalers were catching whales from boats based on shore (Morton 1982:225). Basques, Vikings and North-west Coast (British Columbia) Indians had done so before that. In the South Pacific the Tasmanian shore whaling industry began in 1804 (Morton 1982:225), thus developing the commercial basis and the techniques employed by the New Zealand industry (see Pearson 1983).

In New Zealand two developments assisted in the establishment of the shore whaling industry. By the 1820s the sealing trade was fast declining, and in 1823 the British duty on colonial whale oil was reduced to a pound a tun; a 'tun' of whale oil being reckoned at 252 gallons, *ca.* 1 ton in weight. Two years later duty was reduced to a nominal shilling a tun (Rickard 1965:50-51).

The first shore whaler to set up on the New Zealand coast was an ex-sealer, John Guard, who was at Te Awaiti (in what was to become Tory Channel) in 1827 (Grady 1978:40-41). At first Guard was not equipped for taking oil, and whalebone (or baleen) was all that he was able to save. It was not until 1830 or 1831 that he was whaling for oil and whalebone (Morton 1982:230). To the south, Captain Peter Williams was shore whaling in Preservation Inlet in 1829. The same year Guard transferred his winter whaling operation to Kakapo Bay, Port Underwood, having found whales close inshore in the bay, thus establishing the great Cloudy Bay industry (Grady 1978:40-41).

Rec. Auckland Inst. Mus. 20: 41-63 23 December 1983

The New Zealand shore whaling industry was based upon the right (or 'black') whale *(Eubalaena australis)*, which yielded so-called 'black oil'. The whaling season extended from May to October. Each year the right whale arrived on the New Zealand coast about the beginning of May (Dieffenbach 1843 I:45), having summered in the southern ocean (Gaskin 1972:86-87). Travelling up the east coast of the South Island a large part of them would turn into Cook Strait where Cloudy Bay would provide an ideal calving area of warm shallow water. More whales would pass through Cook Strait and then between Kapiti Island and the mainland to another major calving area in the south Taranaki Bight — known to whalers as "Motherly Bay" (Wakefield 1845 I:340).

Whaling in inshore waters could be undertaken from anchored vessels or from shore stations. A distinction is commonly made between 'bay whaling', whaling from ships anchored in bays, and 'shore whaling', whaling from a base on shore (see Morton 1982:230). Bay whaling vessels sometimes put parties on shore, shore whalers, however, were generally independent of ships, except those that supplied the station and removed the produce. In New Zealand these vessels generally came from Sydney. In 1836 there were 18 vessels bay whaling at Port Underwood, most of them American (Grady 1978: P1.24). When a whale was seen as many as 70 whaleboats from bay whaling vessels and shore stations might set off in pursuit (Morton 1982:231).

The inshore whaling industry very soon destroyed its own means of livelihood. It was mostly cows and calves which were taken, the females coming inshore to calve. The males generally remained out at sea, to be joined there during the summer by the cows and calves in the return to the southern ocean. As early as 1832 a Mr R.W. Hay predicted the end of the New Zealand shore whaling industry (Rickard 1965:109). The peak years were probably 1838-39. Black oil production figures from the Weller brothers' station at Otakou in the southern South Island illustrate dramatically the brief success and rapid decline of the industry. In 1834 the station took 310 tuns of oil. In following years production was 260, 210, 272 and 213 tuns, followed by 65 tuns in 1839, 14 tuns in 1840 and 10 tuns in 1841, after which the station closed (Rickard 1965:111). In the Kapiti/Mana Island region, 23 boats at six stations produced 466 tuns in 1839 (Dieffenbach 1843 I:109). By 1847 only one station remained on Kapiti and one other at Te Korohiwa on the mainland near Mana Island, between them employing three boats and taking 29 tuns of black oil (Wakefield 1848:193).

KAPITI ISLAND

Kapiti Island stands about 6 km off the mainland (Fig. 1). It is almost 10 km long and a little more than 2 km wide. The western coast is backed by cliffs rising directly to the main ridge of the island, 521 m above sea level at the highest point, Tuteremoana. A number of permanent streams make their way eastwards from the high ridge to the easier but still rugged east coast. Level ground is confined to the area around Okupe Lagoon and Waiorua in the north, the flat at Rangatira Point, and a limited area at Wharekohu Bay in the extreme south. Along the east coast the remnants of a raised beach occur discontinuously below the truncated ends of spurs. Never more than 50m wide and generally a great deal less, this platform contains extensive archaeological remains including those of the whalers and contemporary Maori occupation. Off the south-east coast are three tiny islets, Tokomapuna, Motungarara and Tahoramaurea, all of which were occupied by whaling stations at some time in the 1830s and early 1840s.

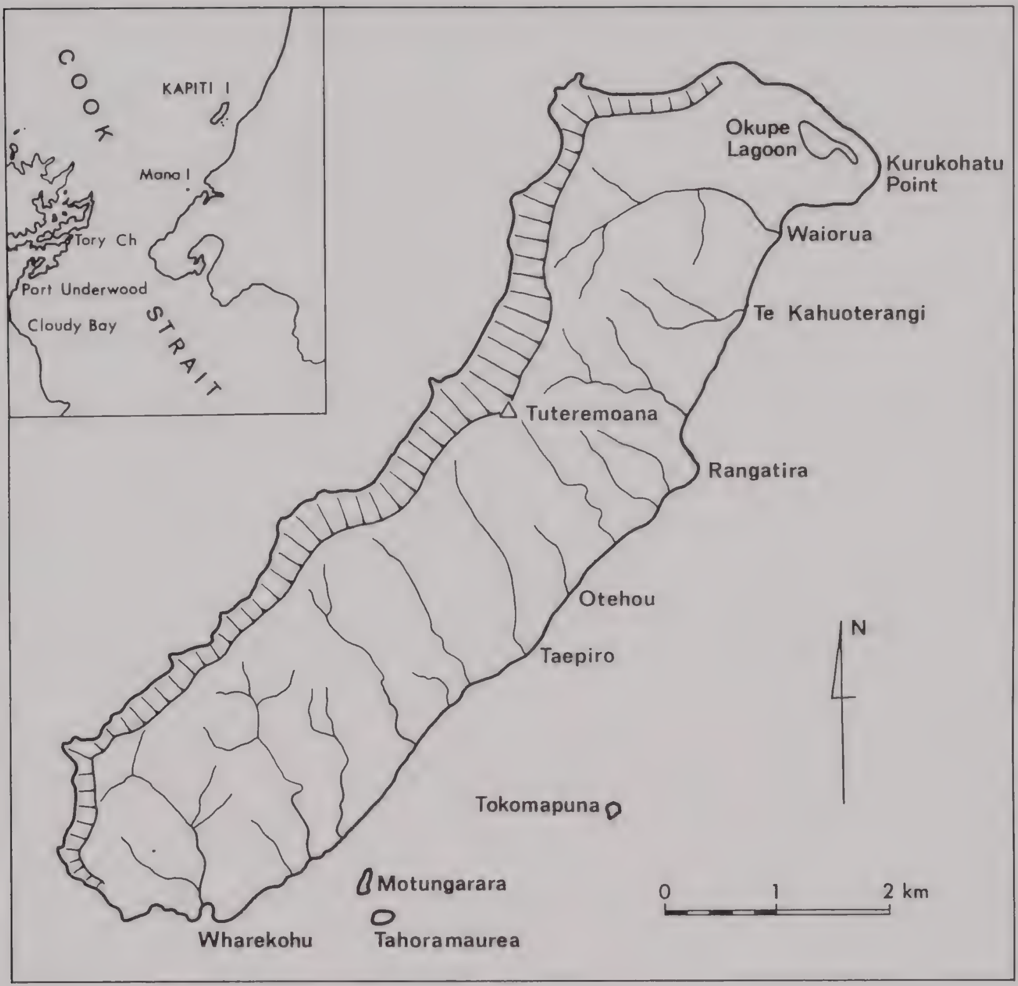

Fig. 1. Map of Kapiti Island showing places mentioned in the text. Inset gives location.

When Dieffenbach visited Kapiti in late 1839 he remarked that, "the whole island is covered with a very vigorous vegetation, mostly of trees, amongst which are fine timber-trees, especially the rata, kahikatea, and rimu" (Dieffenbach 1843 I:108). Since then the island has been largely deforested, much of it being farmed in the late nineteenth century. It is now a scientific reserve administered by the Lands and Survey Department, except for the offshore islets and a limited area at the north end of the main island which is still in Maori hands. A forest vegetation is returning to the island with manuka much the most abundant initial coloniser.

The story of the whaling period at Kapiti is inextricably interwoven with that of Te Rauparaha and his tribe the Ngati Toa, and tribes allied to Te Rauparaha. In 1820 Te Rauparaha was a prominent member of a raiding party from the north which travelled through the Cook Strait region. While in the area he saw two European vessels — one of which may have been Bellingshausen's *Vostok* which was signalled by a fire on a headland when working through the strait on June 9 (Barratt 1979:46). Te Rauparaha at once saw the advantage of living in the area where he might trade with the Pakeha for muskets and other goods. At Kawhia, the Ngati Toa were under tremendous pressure from the Waikato tribes: in late 1821 Te Rauparaha led his people south in a migration to the Cook Strait region. The Ngati Toa and their allies among the Taranaki tribes arrived on the Kapiti coast in 1822 and took the island from the Muaupoko tribe the following year (Smith 1910:392-393).

Shortly after Te Rauparaha's conquest European ships began visiting Kapiti for flax (Wilkinson & Wilkinson 1952:16). The first whalers to visit the area did so about 1827 but it was not until the early 1830s that shore whaling stations were established at Kapiti. On 24 June 1830 the brig *Tranmere* arrived at Port Jackson with a cargo of flax from Kapiti (McNab 1913:5). Captain Smith reported that the *William Stoveld* and the *Hind* were bay whaling there. The *William Stoveld* also appears to have had a party stationed ashore; it returned to Port Jackson on August 13 with 50 tuns of oil and 25 tons of flax.

There is a distinct lack of knowledge of the very first years of Pakeha trade and whaling at Kapiti (see Barton 1974:111). By 1830 and 1831, when we have our first records, European settlement already seems firmly established. A Mr Harvey had set up as a trader, probably at Rangatira, as early as August 1831 (McNab 1913:16; and see Knocks Ms:3), and Samuel Ashmore purchased land at Waiorua in September the same year (Barton 1974:116).

Shore whaling at Kapiti lasted almost twenty years. It began probably in 1830 and ended in the late 1840s. Historical information and archaeological observation suggests there were at least eight places on Kapiti and its offshore islands from which shore whaling was undertaken. From the north these are Waiorua, Te Kahuoterangi, Rangatira, Taepiro and Wharekohu, and the offshore islets Motungarara, Tahoramaurea and Tokomapuna (see Fig. 1). The archaeology of the whaling stations was studied during an Offshore Islands Research Group field trip to Kapiti Island in April 1982.

WAIORUA

The whaling station at Waiorua occupies a small bay sheltered from the north, close to the north end of the island. The area is now Maori land and was for many years farmed by the Webber family. Several holiday baches now stand on the beach ridge which was formerly occupied by the whalers' settlement (Fig. 2). Archaeological remains of the whaling period are thus difficult to isolate from other evidence. The site at Waiorua (New Zealand Archaeological Association site record numbers N156/6 and 7) has been described by Barton (1974:116-117).

When James Cowan visited Kapiti in December 1905 he noted, "one of the whalers' large try-pots, about 4 ft [*ca.* 120 cm] in diameter, is still to be seen intact at the Waiorua landing, with its stone furnace, &c., all complete" (Cowan 1907:3). This trypot is probably the one that now stands close by the front door of one of the cottages (N156/7). Along the foreshore is much old iron, stone walling, boat slipways and other remains, at least some of which will relate to the whaling era but which 100 years of subsequent activity has rendered very difficult to interpret. Sub-surface remains along the beach ridge may be intact but low-lying ground behind has been ploughed, possibly many times.

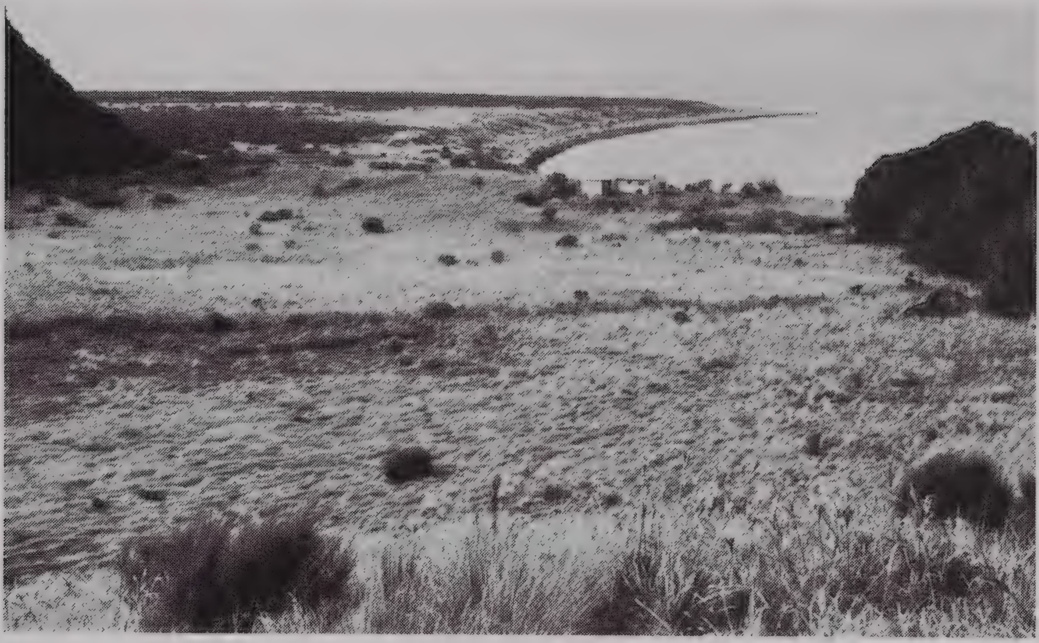

Fig. 2. Waiorua, view north-east to Kurukohatu Point and the mainland (April 1982).

Barton (1974:116) noted a claim for land purchase at Waiorua by one Samuel Ashmore as early as 5 September 1831. It seems likely this is connected to the establishment of a shore whaling station. By the early 1840s Waiorua was the largest station on Kapiti, and probably larger than any on the northern shore of Cook Strait. In 1844 the artist J.A. Gilfillan made a most informative pencil sketch of Gillett's whaling station at Waiorua from the slopes of the hill to the south-west. The original is too pale for useful reproduction; Fig. 3 is an accurate anonymous watercolour copy of Gilfillan's sketch. Small vessels can be seen in the bay, upwards of 35 whalers' huts can be seen, at the south end of the bay is the three legged frame of the scaffold (known as 'shears'; Dieffenbach 1843 I:51) used to raise the whale for cutting up. It seems likely it was Waiorua that was visited by Power in August 1846. He reported 50 or 60 Europeans at the station, ". . . now the largest in New Zealand" (Power 1849:10). Just one year later Gillett's station, now the only one remaining at Kapiti, employed 16 men and two boats, taking 19 tuns of black oil (Wakefield 1848:193).

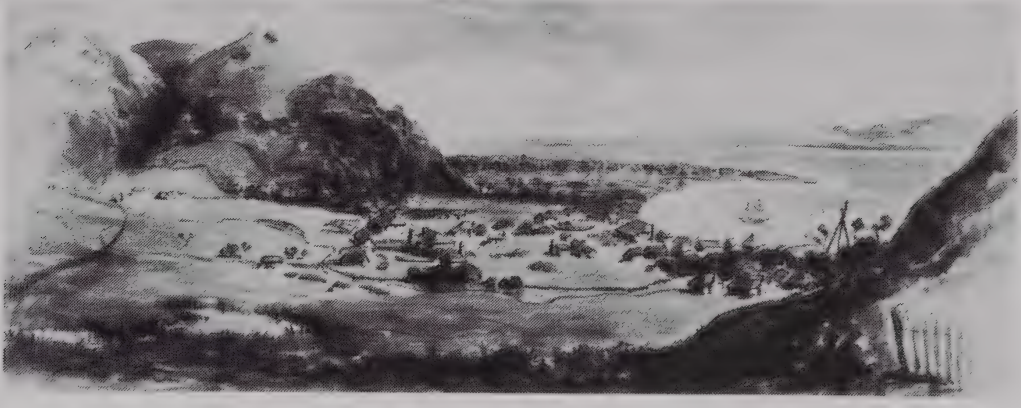

Fig. 3. Gillett's whaling station on Kapiti Island, 1844. Watercolour copy of original pencil sketch by J.A. Gilfillan. (Alexander Turnbull Library D18/12; the Gilfillan sketch is held in the Hocken Library, Sketchbook pp.46-47).

Photo: Alexander Turnbull Library

TE KAHUOTERANGI

Not quite 1 km south of Waiorua Bay are the remains of the Te Kahuoterangi whaling station (N156/9), now under low coastal forest with dense scrub and flax along the foreshore (Fig. 4). Here is the best surface archaeological evidence of any whaling station on Kapiti Island, to be compared only with that on the offshore islets, Tokomapuna and Tahoramaurea. The station occupied a section of raised beach below the steep hillside, almost 200 m long and between 30 and 50 m wide, with terraces also on the flanks of the stream which emerges from a gorge near the south end of the former settlement (Fig. 5). At the front is a 3-4 m scarp to a steeply shelving boulder beach.

When Simcox (1952:136) visited Te Kahuoterangi in 1910 he counted twenty stone hearths at the site. There are now the distinct remains of only nine, some still in good order (see Fig. 6), with other stone scatters signalling those that have collapsed. Close to the beach is the remains of a trypot stand of well finished stonework held together with a clay mortar (Fig. 7). The remains are now *ca.* 1 m high with two side arms enclosing two semi-circular bays 90 and 120 cm (*ca.* 3 ft, 4 ft) in diameter — presumably designed to take trypots of similar diameter. Close to the foot of the hill some 25 m from the trypot stand is a grave. Scattered about the periphery of the site are twelve or more terraces: three occupying rising ground at the north end of the site, others cut into the toe of the hill mostly near the stream, and three more 10 m up a steep spur just upstream. At the south end of the settlement is a depression *ca.* 6 x 3 m lined with large boulders. Fragmentary shell midden is eroding from the north bank of the stream.

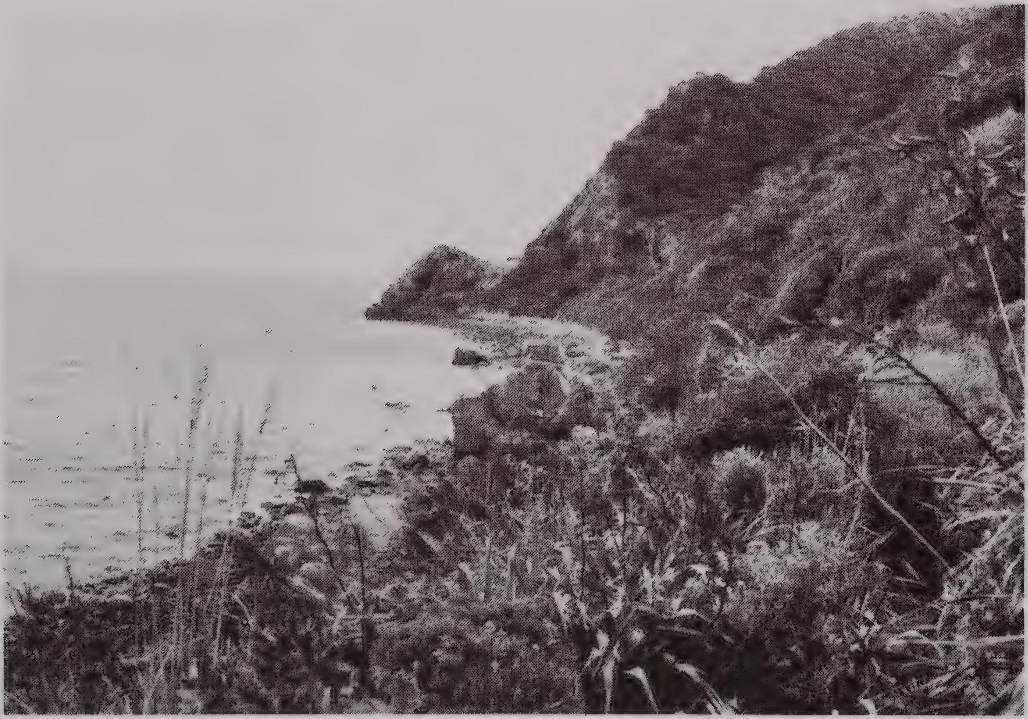

Fig. 4. Site of Te Kahuoterangi whaling station from the north. The station was at the mouth of the gully visible before the skyline ridge. It is now under regenerating coastal forest (April 1982).

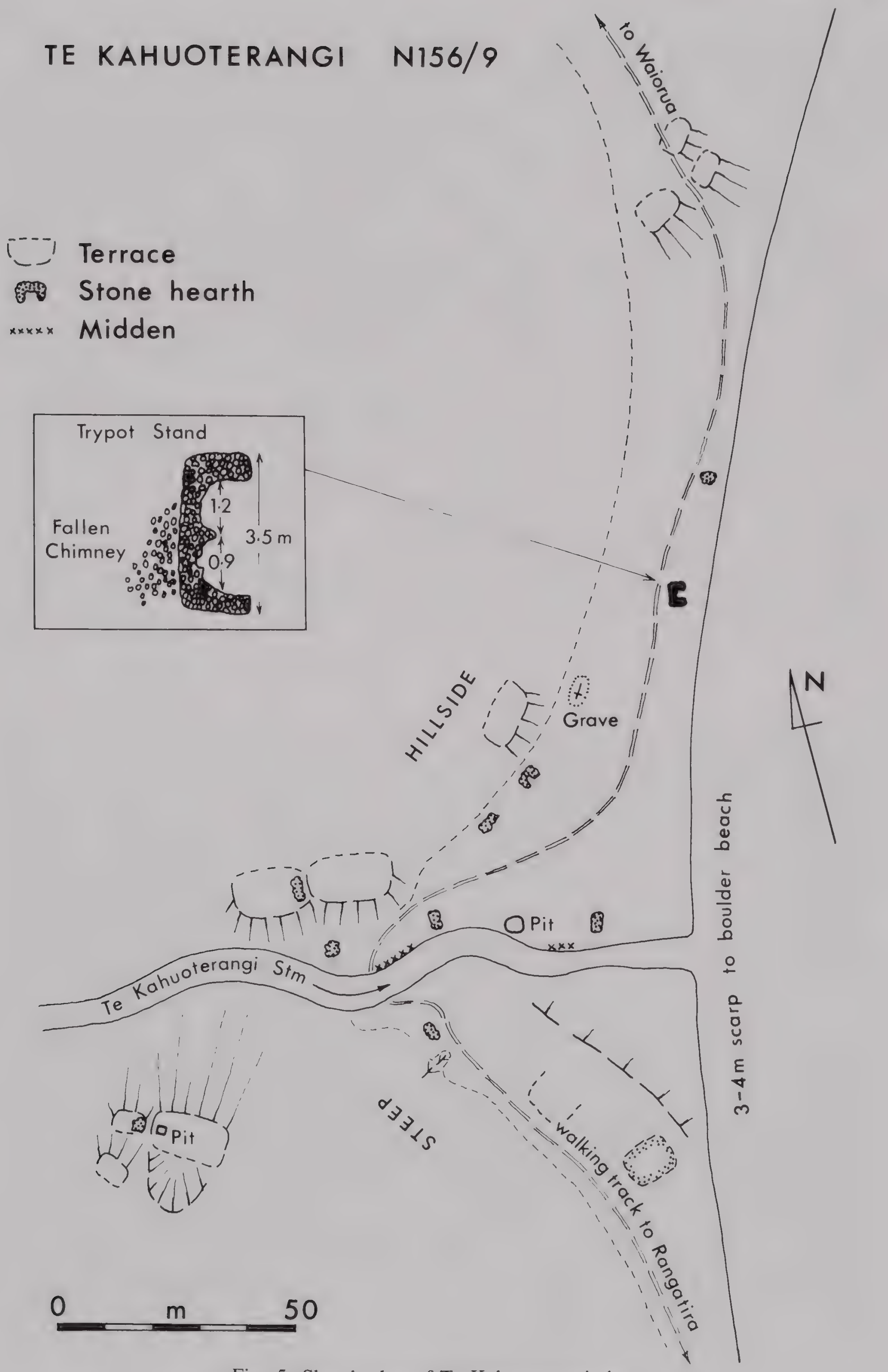

Fig. 5. Sketch plan of Te Kahuoterangi site.

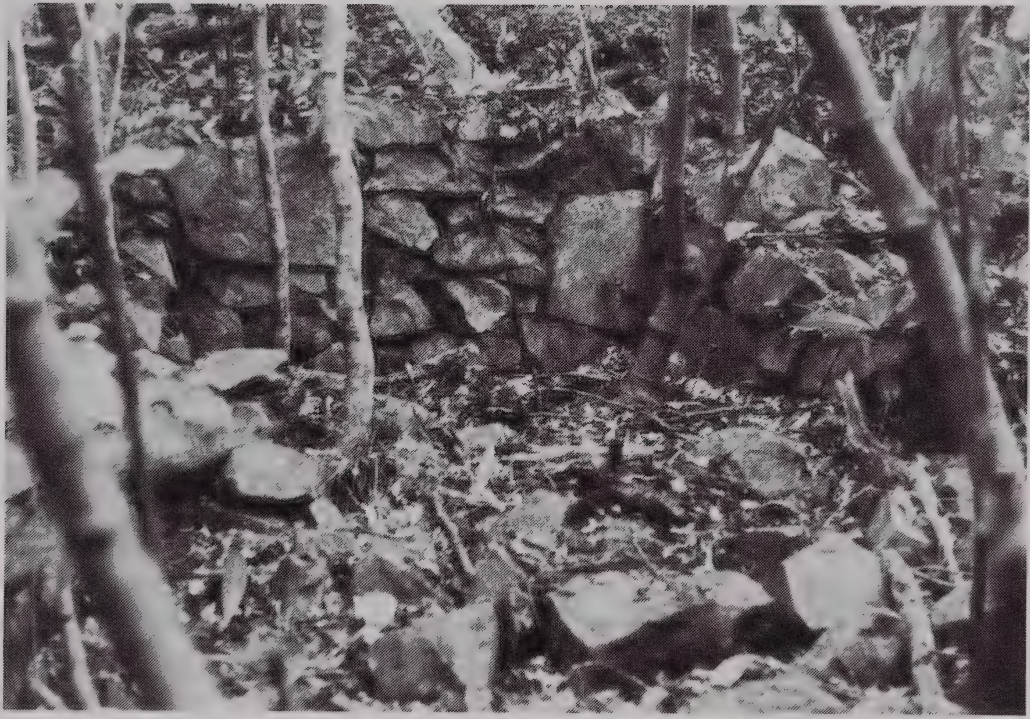

Fig. 6. Stone hearth at Te Kahuoterangi — marked 'A' on Fig.5 (April 1982).

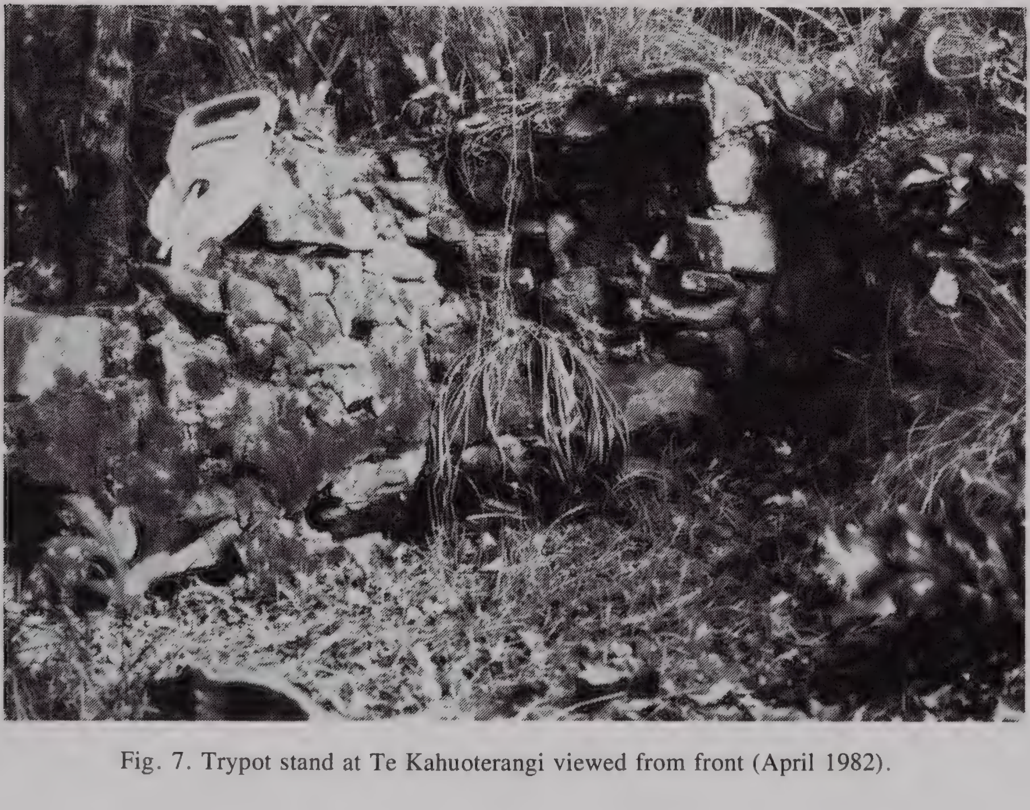

Fig. 7. Trypot stand at Te Kahuoterangi viewed from front (April 1982).

It is not known when Te Kahuoterangi was first occupied by whalers. It was apparently a station of several boats early in 1843 (Wakefield 1845 I:334), and was probably already in operation in late 1839 when Wakefield (1845 I:123) reported two stations on the north end of Kapiti (the other would have been Waiorua). Te Kahuoterangi whaling station may have been closed down within a year or two of Wakefield's 1843 report:Power (1849: 9-11) mentioned only one station on Kapiti in August 1846, probably at Waiorua.

RANGATIRA

An extensive flat almost 500 m long and 200 m across juts out from the precipitous hills of Kapiti 3 km from the north end of the island. The level ground is based on boulders which have been brought together by sea currents and subsequently raised by tectonic movement. It is now covered with rank grass and dense thickets of *Muehlenbeckia* which combine to make thorough searching for archaeological remains extremely difficult.

Archaeological evidence on the flat includes a group of perhaps ten open pits (including a large raised-rim pit open at the north end). Barton (1974:118) reported the raised-rim pit, and another four pits near the eastern tip of the point (N156/12). Near the present landing at the northern base of the triangular flat two trypots are mounted in concrete (N156/11), possibly those removed from Tokomapuna (Simcox 1952:135).

As early as 1831 a Mr Harvey kept a trading establishment at Rangatira (Knocks Ms:3). There is indeed no direct evidence of there having been a whaling station at Rangatira, either archaeological or historical. The first report of a station on the flat is from Cowan who visited Kapiti at the end of 1905 and who reported ". . . the remains of one of the old whaling stations" at Rangatira (Cowan 1907:3). Just what these remains were is not said.

TAEPIRO

Slightly closer to the south than the north end of the island, the Taepiro Stream issues out of its gorge and over a raised beach some 50 m across (Fig. 8). Here there is extensive archaeological evidence (N156/17) which is clearly European in origin and similar to whalers' remains elsewhere about Kapiti (Fig. 9). At the rear of the boulder beach is a scarp generally 2 m high or less. The terrace occupied by the site rises steeply about the Taepiro Stream which is now cut down through debris previously brought down the gorge behind. Immediately behind the raised beach the hillside rises steeply to more than 200 m. North of Taepiro at Otehou is more stonework which might be whalers' work although the site is now in poor condition and does include characteristically Maori features such as pits.

Archaeological evidence at Taepiro is mostly north of the stream mouth. Five metres from the beach is a massive wall of beach boulders, 30 m long, 60-80 cm wide and 1-1.2 m high. At the north end is a gap to some rubble which suggests a former continuation of the wall, now broken down. Two depressions, indicative of houses, survive behind the wall close to the stream. Nearby is a 2 m diameter pit. At the foot of the hill behind is a well built stone platform 5 x 5 m with more boulder faced terraces extending some 40 m to the north. Eight metres from the north-east corner of the stone platform is a European hearth, still 1 m high, made of stone with a clay mortar. On the steep hillside above are at least two terraces. South of the stream the only visible evidence under dense flax, karaka and other vegetation is a 6-8 x 5.5 m terrace with one course of boulders holding the lower side and the remains of a mid-nineteenth century pint 'black' beer bottle.

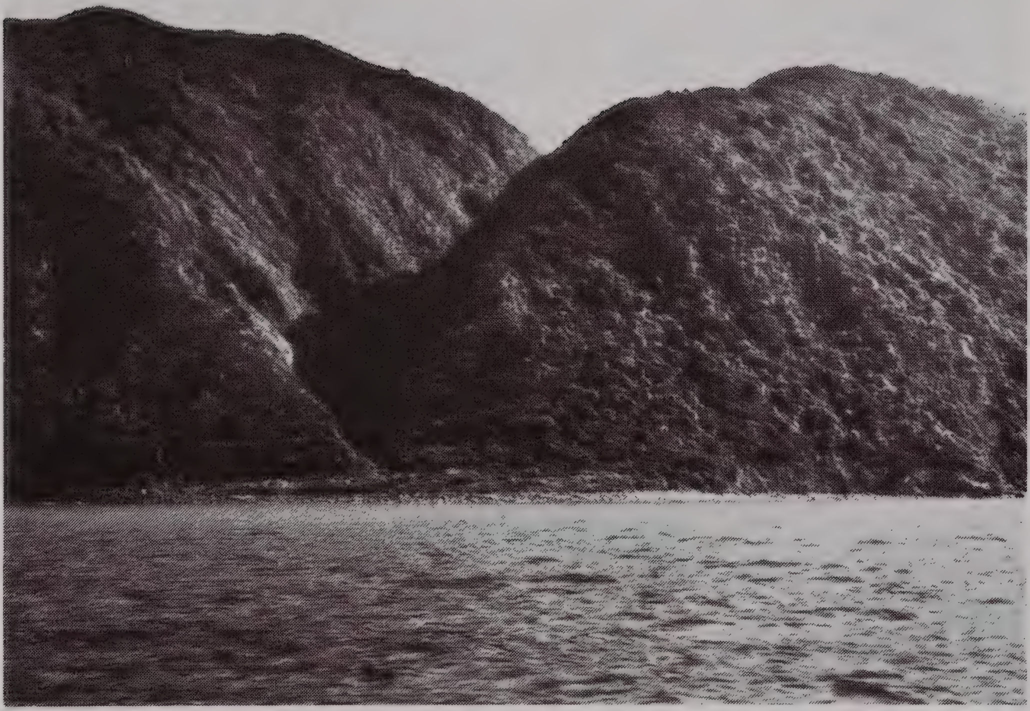

Fig. 8. Taepiro from the sea. The whaling station remains are on the shore platform, right of the gorge (April 1982).

Barton (1974:121) discussed the Maori occupation at Taepiro and concluded that Cowan and others were wrong in placing an historically known pa on the south side of the stream. A Swainson sketch of 1849, however, clearly shows the remains of Maori huts and palisade south of the stream (reproduced in Wilkinson & Wilkinson 1952:P1.3). The sketch also appears to show a more extensive settlement north of the stream. Settlement is also shown north of the stream in an 1837 map (see Barton 1974:121), which may give a clue as to the date of whaler occupation. The archaeological evidence for this whaling station has confirmation from an 1844 Gilfillan pencil sketch which shows whalers preparing to take barrels from Taepiro out to a vessel anchored in the lee of Tahoramaurea and Motungarara (Fig. 10).

WHAREKOHU

The small bay of Wharekohu faces south at the extreme south end of Kapiti Island (Fig. 11). Behind it is a high beach ridge now backed by a small area of flat ground, both dry and swamp. Evidence for shore whaling at Wharekohu depends on statements by such as Simcox (1952:136).

It is difficult unequivocally to relate archaeological evidence to the whaling period because of subsequent farming operations. A 65 m dry-stone wall (N156/26) at the east side of the flat behind the beach ridge probably dates from the farming period. A massive stone hearth (N156/27), and a stone lined drain (N156/28) which extends across the flat

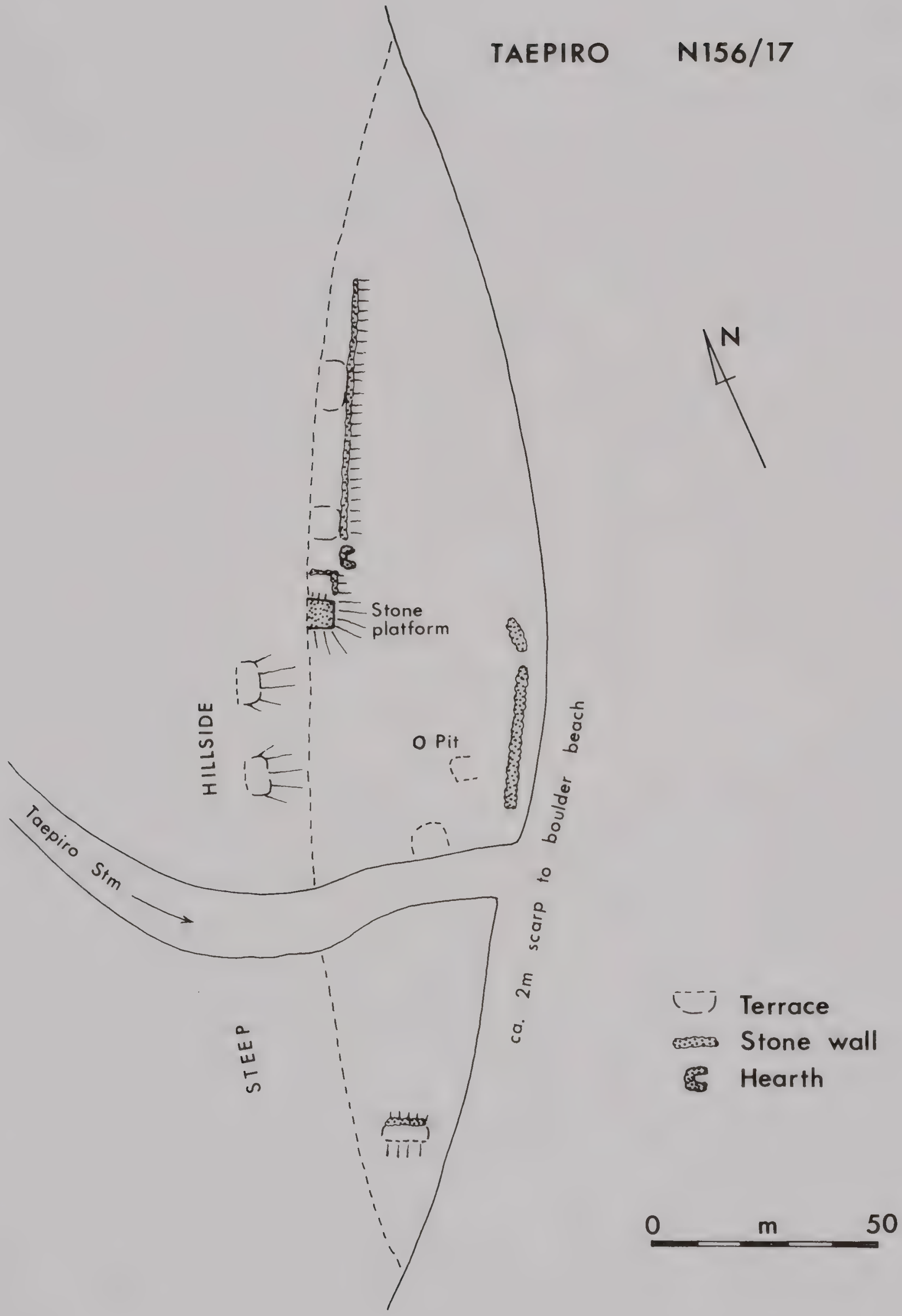

Fig. 9. Sketch plan of Taepiro site.

Fig. 10. "Whaling station at Kapiti", J.A. Gilfillan pencil drawing (Hocken Library, Sketchbook p.70).

Photo: Hocken Library

and part way through the west end of beach ridge (where a spillway and platform opposite clearly indicate a former dam), may be linked to the whaling period, at least in their initial construction and use. Other stone walls between the drain and the foot of the hill to the west (N156/29), and on the rocky shore platform at the west side of the bay (N156/30), probably belong to the farming period.

Wharekohu is sometimes known as Brown's Bay (Simcox 1952:138). In 1839 Maori owners sold 617 acres about Wharekohu to Captain Mayhew who ran a whaling station on Tahoramaurea Island nearby (Wilkinson & Wilkinson 1952:20-23). Andrew Brown, who managed a store for Mayhew and who was connected to him by marriage, later took over the title which was confirmed in 1851. In 1849 Swainson pictured two huts behind a low fence on the beach ridge with what may be a whaleboat on the beach in front (Wilkinson & Wilkinson 1952:Pl.3). Brown farmed at Wharekohu in the 1850s and 1860s (Simcox 1952:138).

MOTUNGARARA

Motungarara is the innermost of the three small islands off Kapiti (Fig. 12). Separated from Kapiti by a 350 m channel, it is *ca*. 300 m long and 30-100 m wide. A rocky spine extends along the western half of the island reaching almost 20 m above sea level near the southern end. Along the eastern side of the island is a raised beach terrace 15-30 m wide, only 1-2 m above high tide. Over the northern part of this terrace several holiday baches and associated paths, sheds and a barbecue area obscure older archaeological

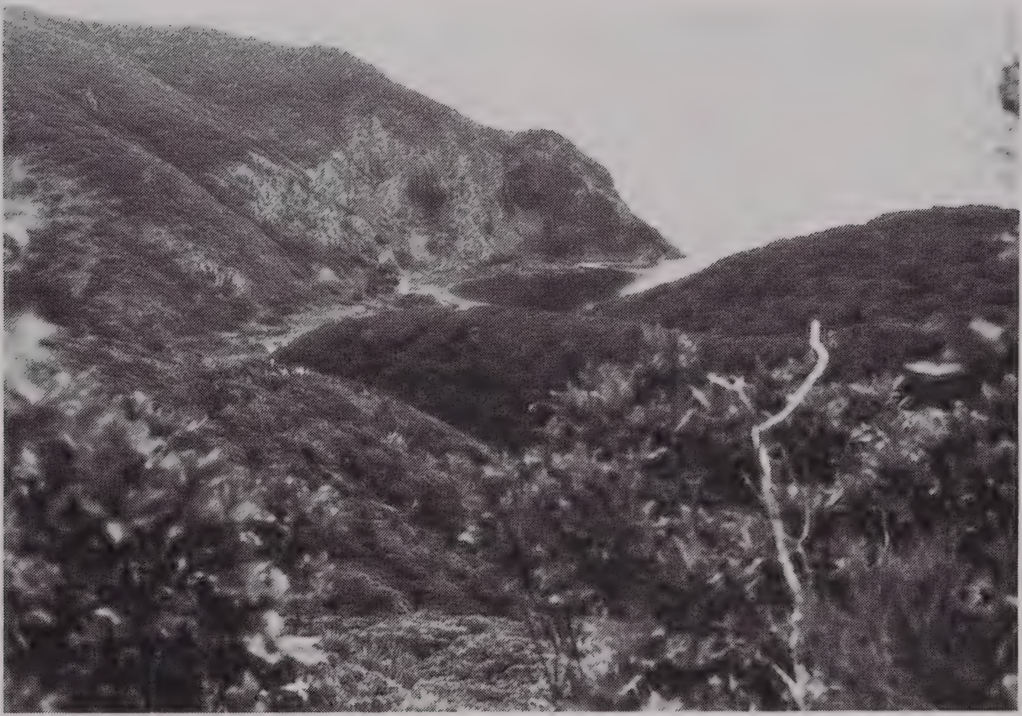

Fig. 11. Wharekohu from the west (April 1982).

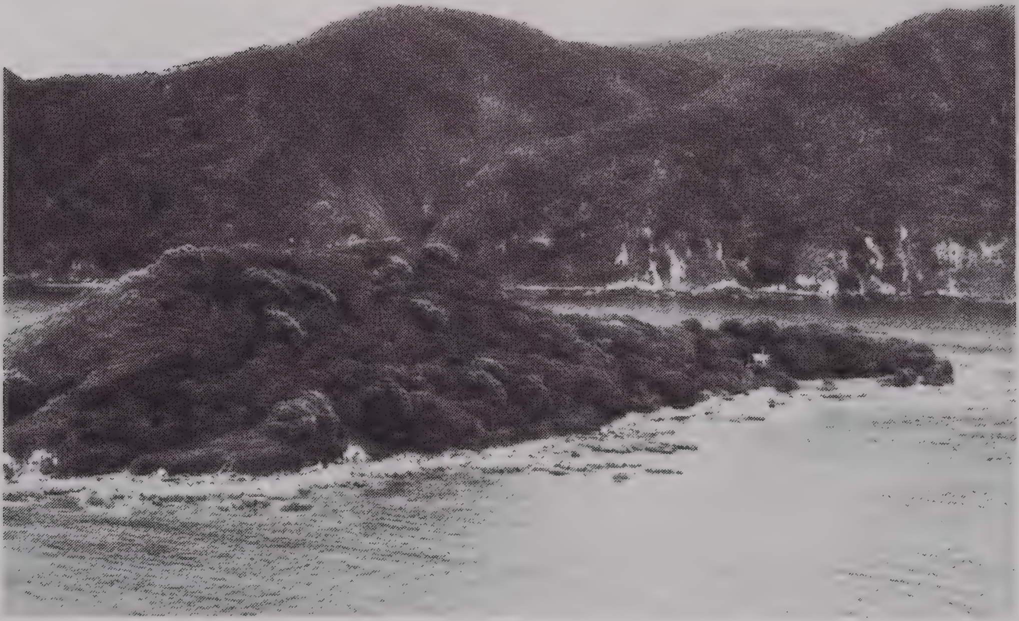

Fig. 12. Motungarara from the summit of nearby Tahoramaurea. The whaling station was on the shore platform on the near side of the island, extending to the north (right) end (April 1982).

evidence. To the south, under second growth bush, are the remains of at least four dry-stone walls (Fig. 13), nowhere more than a metre high, which are either parallel or at right angles to the beach (N156/31). These walls are characteristic of whalers' work. They are made of schistose rock which outcrops on Motungarara and Tahoramaurea and near Rangatira Point on Kapiti. (The walls are thus strongly reminiscent of miners' work in Central Otago — although Fleming & Hutton (1949) have identified the Kapiti material as phyllonite and not schist.) In December 1980 Bruce McFadgen recovered a crouch burial (N156/35) with associated bone needle and drilled fish spine from a wave eroded section on the north-east side of the island.

Motungarara has also been known variously as Hiko's Island (Dieffenbach 1843 I:99), Lewis Island (Morton 1982:160), and Fisherman's Island (Macmorran 1977:23). Te Hiko-o-terangi was a Ngati Toa chief, son of the famous Te Pehi, who lived on the island for some years. About 1840 he was engaged in whaling with one boat but gave it up soon after. A report at the time states why: "he has lately abandoned his occupation, and sold his boat, giving this extraordinary reason, that he has become a missionary and says that if it be good to rest one day of the week, it must be much better to rest the whole week" (Carkeek 1966:49). Te Hiko left the island in the early 1840s (Wakefield 1845 II:65).

When Dieffenbach visited Motungarara in October 1839 vegetation was reduced to a few clumps of flax and ". . . a species of Linum with blue flowers", probably *Linum marginale,* an Australian introduction. On the raised beach of the north-west side of the island stood ". . . the homes of the Europeans employed in whaling, and several huts of

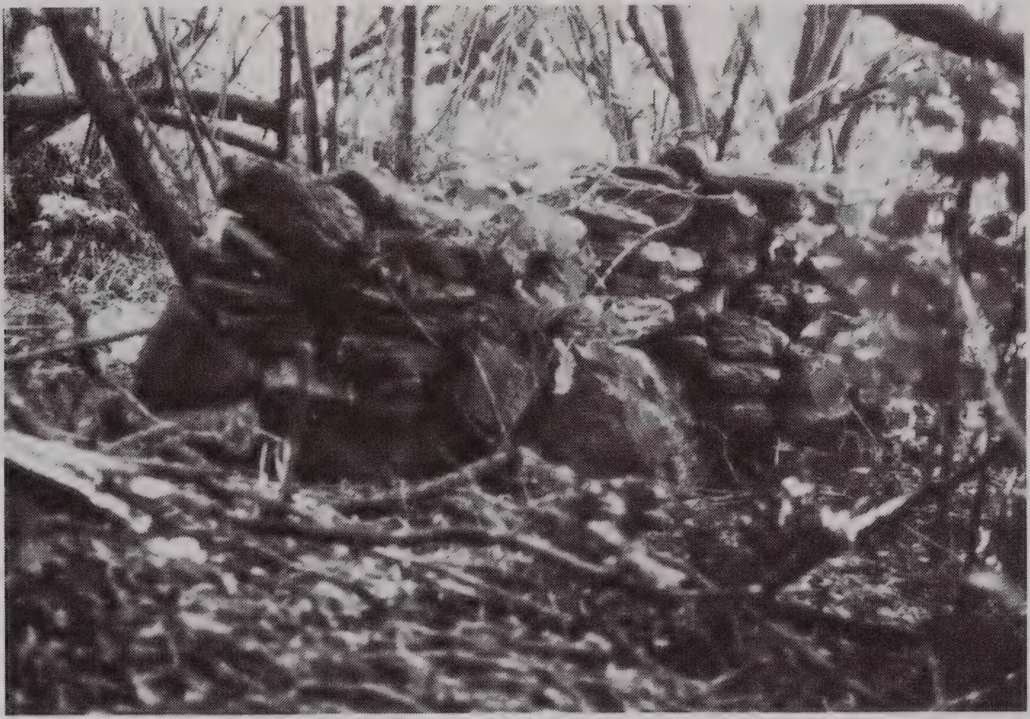

Fig. 13. Stone wall (N156/31) on Motungarara (April 1982).

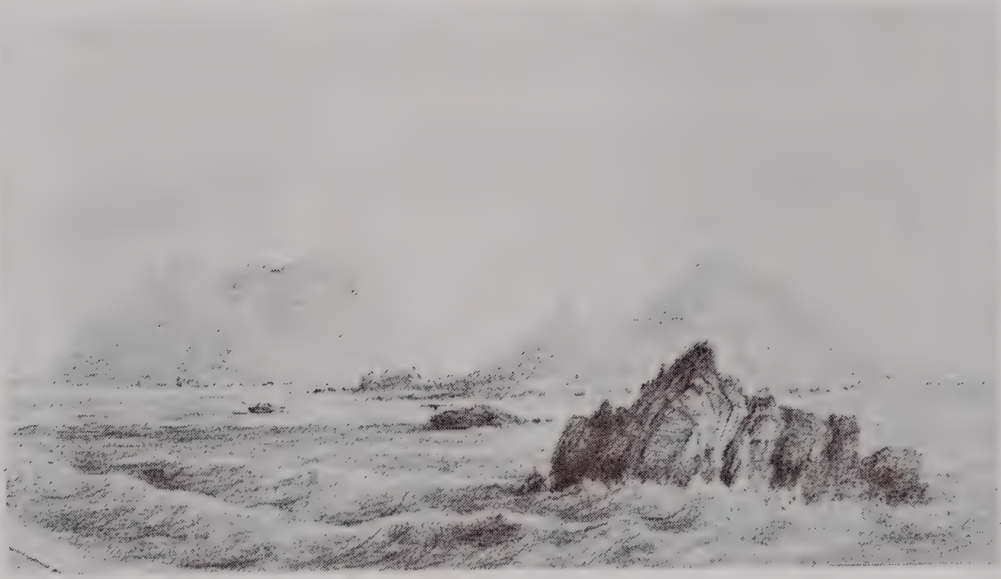

Fig. 14. "The deserted whaling station, Brown's Island, Kapiti" (April 1849), William Swainson pencil drawing (Hocken Library). The picture shows Tahoramaurea (left) and Motungarara Islands; the European style building and nearby Maori palisade is on the shore platform of the north end of Motungarara.
Photo: Hocken Library

the natives" (Dieffenbach 1843 I:111). The whalers on Motungarara in 1839 were Americans (Dieffenbach 1843 I:99), under the command of Captain ('Horse') Lewis (Wakefield 1845 I:138).

Among sketches by William Swainson, who visited Kapiti in April 1849, are several that show Motungarara, quite without vegetation, with the remains of the Maori settlement and whaling station, both said to be deserted by this time (Fig. 14). An 1844 sketch by Gilfillan (Hocken Library, Sketchbook p. 45) gives another view of the shore platform with a single hut close to the position of the stone wall shown in Fig. 13. A light palisade fence runs along the foreshore.

TAHORAMAUREA

A pass of little more than 100 m separates Motungarara from the adjacent island of Tahoramaurea. Here archaeological evidence is more abundant, there being no present occupation to mask or displace the earlier remains.

Tahoramaurea is almost 200 m long and perhaps 140 m wide. On the north and south-east sides are raised beaches, above which the island rises steeply to a plateau 80 x 40 m which is *ca*. 35 m above sea level. Present vegetation is dominated by bracken on the plateau and northern faces, and flax, taupata and other hardy species on the raised beach and southern faces. Archaeological remains may be divided conveniently into those on the raised beaches at opposite sides of the island, and the more difficult evidence on and about the summit plateau (Fig. 15).

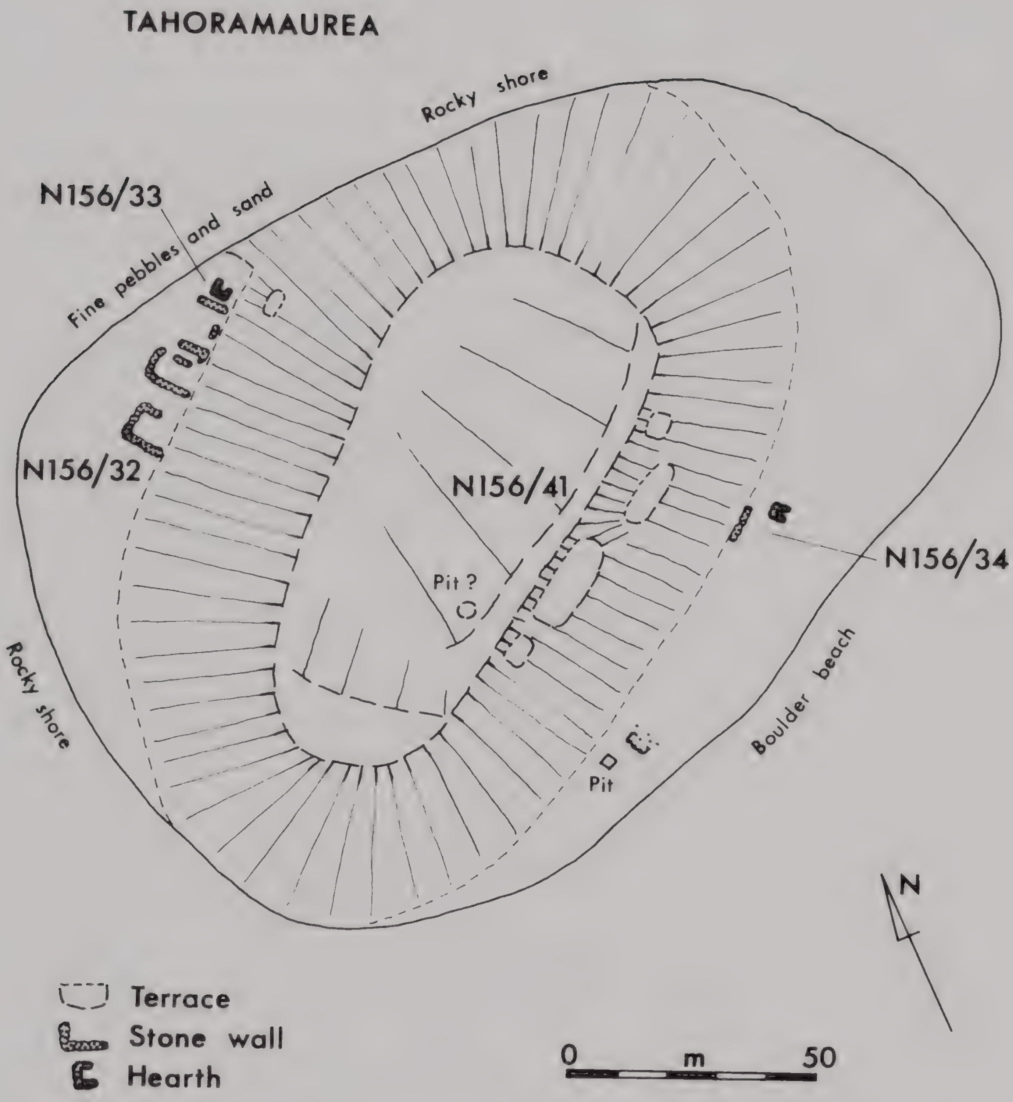

Fig. 15. Sketch plan of Tahoramaurea showing remains of shore whaling establishments, and other archaeological evidence.

On the northern side of the island is a roughly triangular area of flat ground only 1-2 m above high tide, approximately 100 m long by 30 m wide. The southern half is now under dense flax amongst which no archaeological remains could be found. Against the foot of the steep slope to the island summit, extending from the north-eastern end of raised beach a total length of about 40 m, are the remains of several stone-walled buildings and stone hearths. At the north-east end a massive hearth (N156/33) of the same schist-like phyllonite as is used on Motungarara is fronted by a 5 x 5 m hut platform, directly adjacent to and only 1 m above the beach. The hearth is of unmortared construction and measures *ca*. 1.2 m high, 1.5 m across with arms 1.8 m and 1.5 m long. The walls are more than 1 m thick. On the steep hillside 5 m above the hearth is a terrace 6 x 3 m. Extending to the south-west are the well preserved remains of three or more stone-walled houses backed up against the foot of the scarp (N156/32). At least one hearth can be made out under the now dense vegetation. Some of the walls appear to be of earth core faced by stone.

On the south-east side of the island the raised beach is 150 m long and as much as 40 m wide. Archaeological evidence here is confined to a hearth and adjacent wall built to hold the foot of the hill (Fig. 16), — clearly the remains of a single hut. On the narrowing south-west end of the terrace is a pit 1.5 x 1.5 m and 1 m deep, next to which a loose pile of boulders may signal another hearth.

The broad top of the island (N156/41) seems likely to have been extensively occupied although only a single possible pit is now visible under the dense bracken. Occupying an exposed situation just below the south-east rim of the plateau are four terraces, two of them (20 x 6 m, 15 x 5 m) still well formed.

Tahoramaurea, like Motungarara, has been known by a variety of names, including Rauparaha's Island (Dieffenbach 1843 I:98), Mayhew's Island (Dieffenbach 1843 I:99) and Brown's Island (Macmorran 1977:23). The island was for some time the home of Te Rauparaha who was occupying a few huts on the raised beach of the northern side when the New Zealand Company vessel, *Tory,* anchored in the roadstead in October 1839 (Dieffenbach 1843 I:111). Captain William Mayhew was an American who was at the same time operating a two boat whaling station from the shore platform on the opposite (south-east) side of the island (Dieffenbach 1843 I:109 and 111). Andrew Brown ran a store for Mayhew on the island and later farmed at Wharekohu (Wilkinson & Wilkinson 1952:20-23).

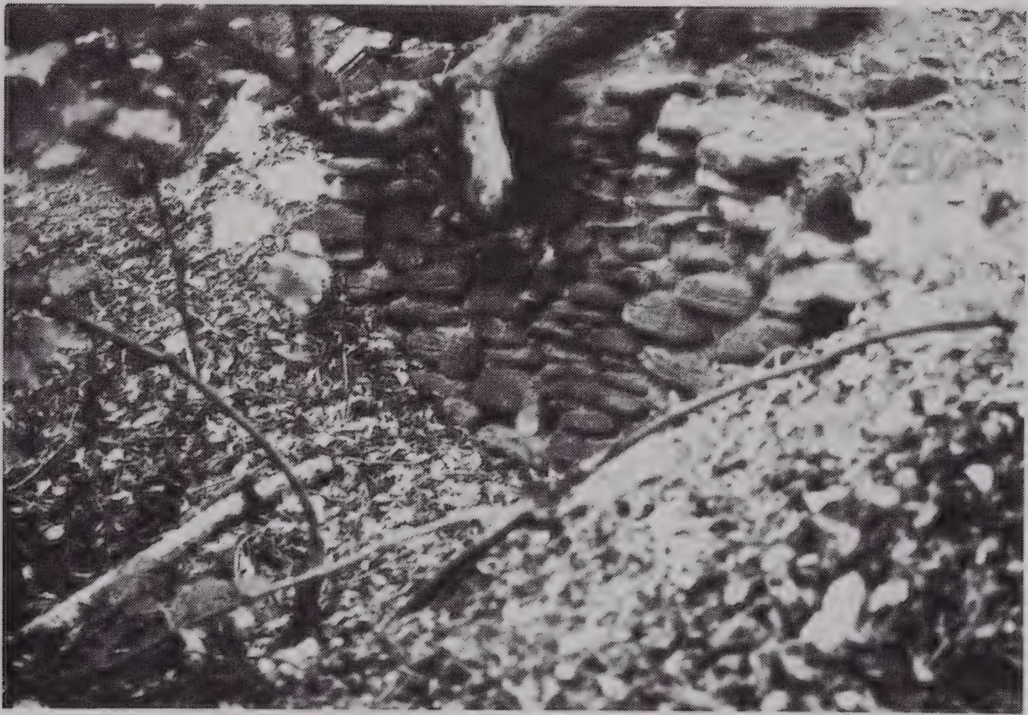

Fig. 16. Stone revetting at hut site N156/34 on Tahoramaurea (April 1982).

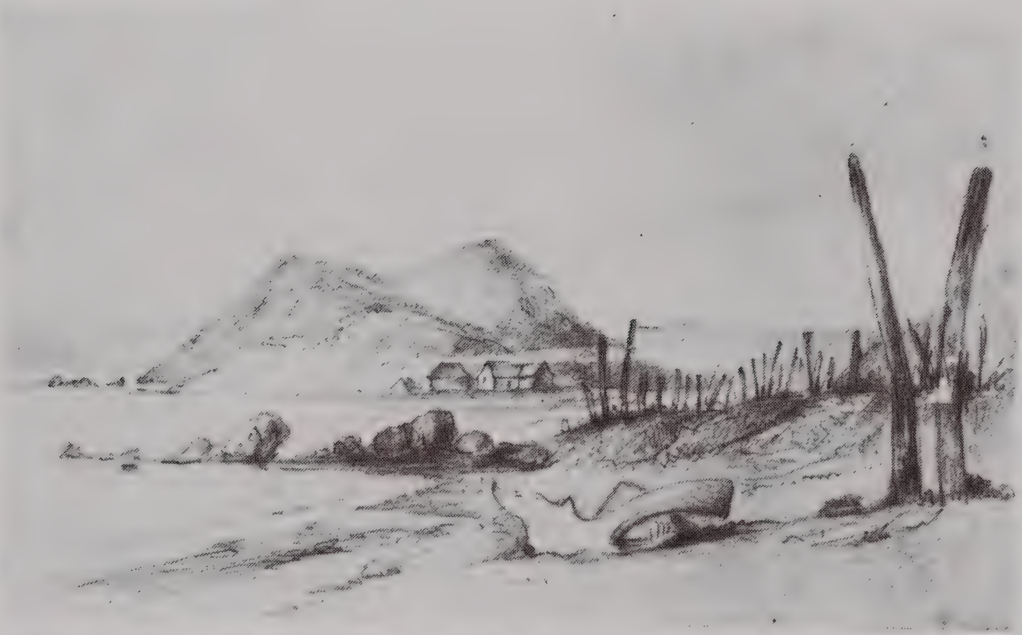

Fig. 17. ''Brown's deserted whaling station, Kapiti island'' (April 1849), Mary Marshall after William Swainson (private collection).
Photo: Alexander Turnbull Library

Among the Swainson sketches dating from April 1849 are several depicting ''Brown's Island'' (he actually called both Tahoramaurea and Motungarara ''Brown's'' which may have been usage at that time). The most interesting shows ''Brown's whaling station'' from Motungarara (Fig. 17). In the foreground are the decaying palisades of Te Hiko's settlement, while to the rear are three or more European style buildings on the northern shore platform of Tahoramaurea. This cluster of European buildings is also shown in Gilfillan's 1844 sketch (Hocken Library, Sketchbook p.45) where perhaps six buildings can just be made out. The historical evidence in these two sketches would nicely account for the present archaeological evidence, and indicates that when Te Rauparaha left, Mayhew (or, by then, Brown) shifted operations to the sheltered northern side of the island.

TOKOMAPUNA

The third islet used by whalers is Tokomapuna, *ca.* 1.5 km off Kapiti and a little more than 2 km from Motungarara and Tahoramaurea. The island is now covered in dense taupata, pohutukawa, ngaio, mahoe, and boxthorn and blackberry which makes thorough searching very difficult. The island is largely flat, 2-5 m above high water. A high point, *ca.* 12 m above sea level, stands above the south end of the island, while a low ridge, rising to the north, extends part way along the west side. Archaeological evidence includes the remains of seven stone hearths (undoubtedly there are more under dense patches of blackberry), and three small terraces on the western slope of the low ridge (Fig. 18). These clearly relate to living accommodation for the whalers. The beach at the

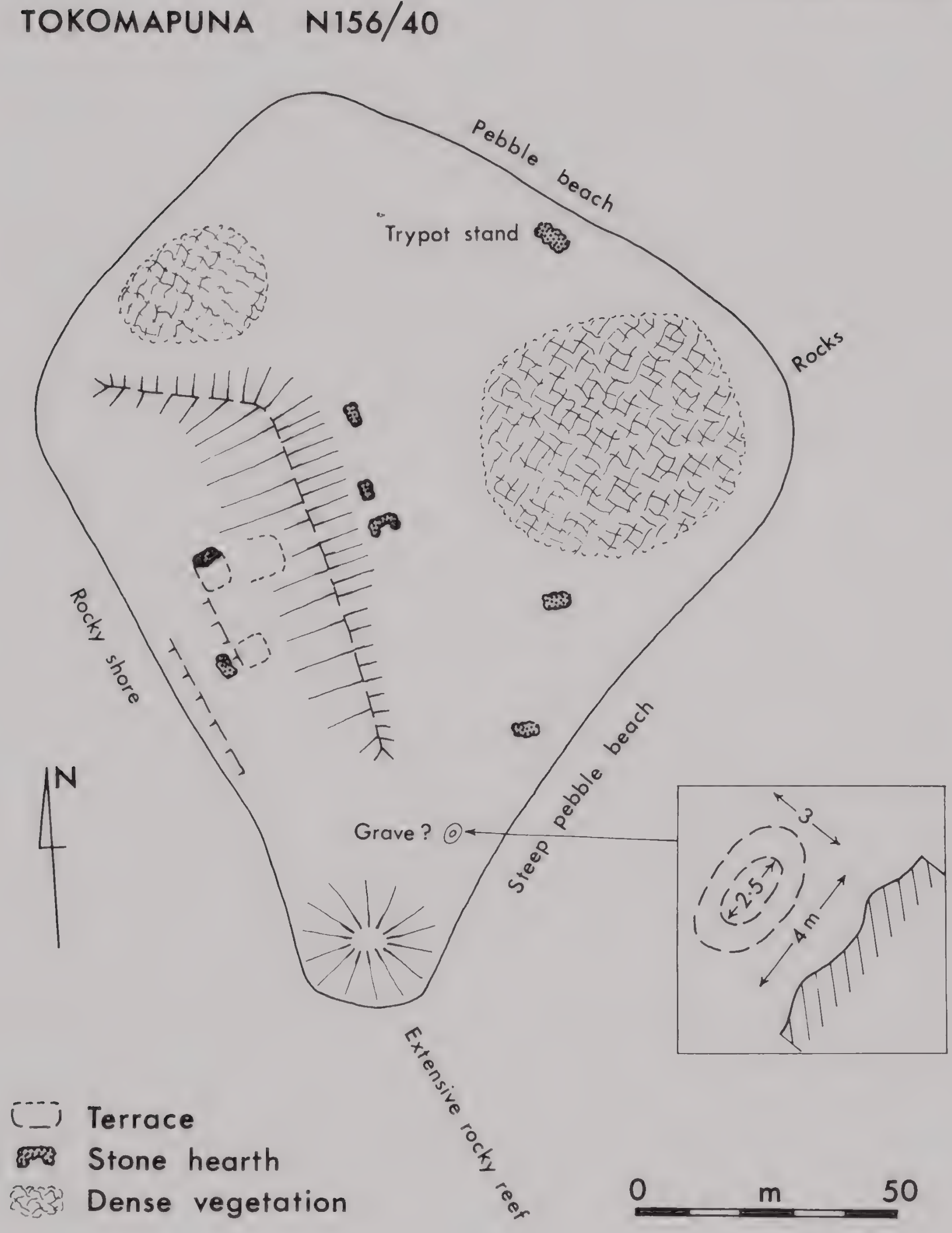

Fig. 18. Sketch plan of Tokomapuna showing archaeological remains of shore whaling station.

north-east side, protected to the south-east by a chain of large rocks extending out from the island, would have provided the whalers with a place to launch their boats and 'try-out' their whales. A large mound of boulders immediately behind this beach marks the site of the former try-works. Other surface archaeological evidence consists of an oval hollow mount beneath the high point at the south end of the island, probably a whaler's grave, and possible revetting of the western edge of an extensive level area which lies beneath the hut terraces west of the low ridge.

Like the other whalers' islands, Tokomapuna has been known by a variety of names. The list includes Evan's Island (Dieffenbach 1843 I:98), Cockatoo Isle and Aeroplane Island (Macmorran 1977:22). Tommy Evans was the most famous of the Kapiti whalers. Wakefield (1845 I:122-123, and see 331-333) wrote that,

> "The whaling-station on Evans Island we found to be more complete, and under more thorough discipline and efficient management, than those in Port Underwood or at *Te-awa-iti*. The boats put off after a whale just as we arrived, and struck us by their precision and good appointment."

In 1839, 23 boats at six Kapiti and Mana whaling stations produced 466 tuns of whale oil of which more than half was produced at the six boat station on Tokomapuna (Dieffenbach 1843 I:109).

DISCUSSION

Whalers played a crucial early role in contacts between Maori and Pakeha in New Zealand. To many observers their hehaviour and influence was deplorable (see Morton 1982:198), but other observers (e.g. Wakefield 1845 1:335-338), and commentators since (e.g. Millar 1971; Morton 1982: 210-224), have been more willing to concede the positive effects of their activity and influence.

The shore whalers came to New Zealand as part of a worldwide commercial enterprise. Those who came, like the Sydney merchants who backed them, were interested firstly in profits. This commercialism was quickly appreciated by the Maori who had their own objectives in trade and their own goods and services for sale. Te Rauparaha in particular was highly desirous of trade with the Pakeha and, having moved to the Kapiti region, partly at least, to benefit from this, gave encouragement to Europeans to settle among his tribe, bringing with them their access to the material things of the outside world.

There was, nonetheless, not a little friction in resolving the differing objectives and ways of doing things between the whalers and traders of these early decades and their Maori hosts. The uninhibited nature of this early contact at Kororareka in the Bay of Islands is well known (e.g. see Wright 1967:69-76). The best account of contact and conflict between whaler and Maori in the Cook Strait region comes from Wakefield (1845 I:308-343) who spent four weeks with Kapiti whalers in June and July 1840.

As an energetic young man himself, Wakefield was captivated by the energy and marked lack of 'humbug' shown by the whaling community. He describes a way of life in which the whalers lived close to their Maori hosts, and were accommodated within Maori society, if not entirely on Maori terms then certainly closer to it than their links with the world beyond New Zealand would suggest was necessary. Recently, Millar (1971) has described the economic and social relationships of whaler and Maori in the Cook Strait region. A more general discussion was given by Morton (1982).

At first it was flax which interested the Sydney merchants. The power of Te Rauparaha ensured that he could concentrate flax production from the Cook Strait region and so draw trade to Kapiti. By 1830 the island was a centre of the New Zealand flax trade

(Millar 1971:63). A major Maori reason for engaging in this trade is illustrated from the log of H.M.S. *Zebra*, which visited Kapiti in March 1832 only to find Te Rauparaha and his fighting men away in Banks Peninsula using guns acquired through the flax trade to attack the people there (McNab 1913:59). Other trade goods were listed by McNab (1913:4 and 12) as including tomahawks, pipes, tobacco, fishhooks, clasp knives, gunpowder, cartridge paper, bullets, cartouche boxes, bayonets, cutlasses, bullet moulds, leather belts, rum, cotton handkerchiefs and blankets. In addition to flax, the traders sought pigs, potatoes and curios.

If Te Rauparaha's political power concentrated the flax trade at Kapiti, it was the natural advantage of the island which drew the whalers. Whereas the flax trade, however, could be carried on by a handful of traders to act as middlemen, the whaling industry required a large work force which was mostly, though not entirely, Pakeha rather than Maori.

Shore whalers were generally recruited in Sydney by entrepreneurs who would equip a party and transport it to New Zealand at the beginning of each season, returning to take off men and oil at the season's end. Other shore whaling parties could be part of the operations of American vessels operating in New Zealand waters or may have jumped ship from American or other whalers. "With their warm huts, Maori mistresses or wives, and ample supplies of cheap rum, shore stations offered permanent temptations to sea-tossed crews" (Millar 1971:60).

Not all whalers would return to Sydney at the end of each season, however, and throughout the 1830s increasing numbers remained in New Zealand over the summer. Dieffenbach (1843 I:41) described how they lived from his observations at Te Awaiti:

> "In the summer season the whalers live dispersed over the Sound; sometimes trading in a small way with the passing ships in potatoes and pigs, which they obtain through the families of their wives, but more generally spending their lives in idleness. There are, however, some very respectable men amongst them, who have been provident enough to cultivate small patches of ground . . ."

Wakefield (1845 I:323-324) describes how both permanent and seasonal residents among the whalers would be provided with women from among their host tribe. The arrangement imposed obligations on both sides with the 'wife' cooking, keeping house, and mending clothes for the whaler, and providing hospitality on his behalf. The whaler kept his 'wife' and, to a degree at least, provided for her relatives as well, although it is clear that this too was reciprocal and that Maori families could provide much for 'their Pakeha' by way of food, accommodation and goods for trade.

Further to the practical and economic aspects of whalers taking Maori wives was the social or kin aspect. Maori women did not lose tribal links or inheritance by marrying a Pakeha; many Maori today count a whaler among their ancestors. Thus whalers were drawn into a fundamentally Maori community economically, socially and ultimately, genealogically, at the same time providing their Maori communities with access to the world outside New Zealand.

To the archaeologist, the whalers and their interaction with the Maori offer an opportunity to examine both early nineteenth century European material culture in New

Zealand and the nature of an aspect of the early Maori-Pakeha relationship. There are few enough types of European settlement or areas of social contact in New Zealand which date from before 1840 and which are open to archaeological study: the missions offer another, but archaeological remains of others, such as sealing, trading and early European voyager contacts, are problematic indeed.

With its eight whaling station sites Kapiti may provide the foremost archaeological resource in New Zealand for the study of the early whaling industry. Other places with early whaling activity also deserve archaeological attention, however, in particular Preservation Inlet, Foveaux Strait and the Otago Coast, Banks Peninsula, Cloudy Bay and Tory Channel and Hawke's Bay. It is likely too that important archaeological deposits relating to the resting and supplying of pelagic whalers are still present at Russell (Kororareka).

Archaeological site surveying at Kapiti indicates something of the nature of shore whalers' settlement sites. Stonework is common, usually unmortared but occasionally with a mud mortar or earth core. European style fireplaces are sometimes in good order but are now more often featureless piles of boulders. Pieces of early nineteenth century bottle glass may be found, while barrel hoops and other iron fragments are present on some sites. Frequently, however, surface remains can date from post-whaling settlement or visitors, as at Tahoramaurea where stoneware and bottle glass fragments on the site are mostly of late nineteenth or early twentieth century date.

There is a need for excavation to examine the material culture of the whalers and define the material aspects of their relationship with the Maori as part of a wider study of the process of culture contact. In New Zealand the only excavation of a whaling site so far undertaken is that of Coutts at Taieri Island off the south Otago coast. Coutts' (1976) conclusions relate to the mixed Maori/Pakeha population evident from the archaeological remains, and the difference between the remains and those excavated at Maori living sites elsewhere in the region. The lack of excavation of early European settlement sites of other kinds at the time he did his work leaves open the definition of particular characteristics of the material culture of New Zealand shore whalers.

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EXCAVATIONS AT AOTEA, WAIKATO, 1972-75

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Abstract. The excavation of four prehistoric terrace sites on the Waikato coast, near Aotea Harbour, is described. The settlement dates to the late fifteenth or early sixteenth century A.D. The excavations shed light on the nature of undefended terrace settlements. Features identified include a sleeping house, a cooking shed, working areas and a variety of storage pits. An economic analysis shows the importance of stored horticultural produce and the lesser importance of shellfish and fish.

The excavations at Aotea were undertaken by Richard Cassels as part of an ambitious scheme for a complete survey of the prehistoric Maori occupation of the west coast between Aotea and Raglan harbours (Fig. 1). It was designed to complement a previous survey of the inland region of the upper Waikato basin (Cassels 1972a, b) and to discover any significant differences in the settlement patterns in the two areas which are separated by the Pirongia Range. In the summer of 1971-2, some 100 sites on map N64 were recorded and incorporated in the New Zealand Archaeological Association's file at the Waikato Museum (Cassels 1972c). The remarkable concentration of midden and other sites at Aotea North Head (Fig. 2), close to the large elaborate Manuaitu pa and its associated sacred *tuahu* stones (N64/97) indicated that further investigation of a limited area here would be profitable. Accordingly in 1972-3 a small-scale excavation of a terraced site (N64/25) was undertaken, together with a sampling of over 100 shell middens exposed in the dunes.

The results of the midden analysis were presented to the IXth I.N.Q.U.A. congress at Christchurch as 'Patterns of prehistoric resource exploitation at Aotea' (Cassels 1973) but the report of the terraced settlement was deferred, pending some investigation of an associated field system and borrow pits (Walton MS) and the planning of Manuaitu pa (Fox 1976: fig. 37). Cassels found himself unable to complete the report and when leaving Auckland in 1982, suggested to Aileen Fox that she should. The report which follows is limited in scope; although essentially a joint work, responsibility for different sections has been indicated by the author's initials.

THE SETTING

The north head of Aotea Harbour is the tip of a long peninsula extending for some 8 km along the west coast as far as the Toreparu Stream. The dominant feature of the relief is the 152 m (500 ft) high bluff of Manuaitu pa built on an old basaltic dome, a formation which continues south-west towards the coast at Taranaki Point (Fig.2). South of Manuaitu, the ground slopes gently down towards the Head until it meets with the line of massive sand dunes rising to 91 m (300 ft).

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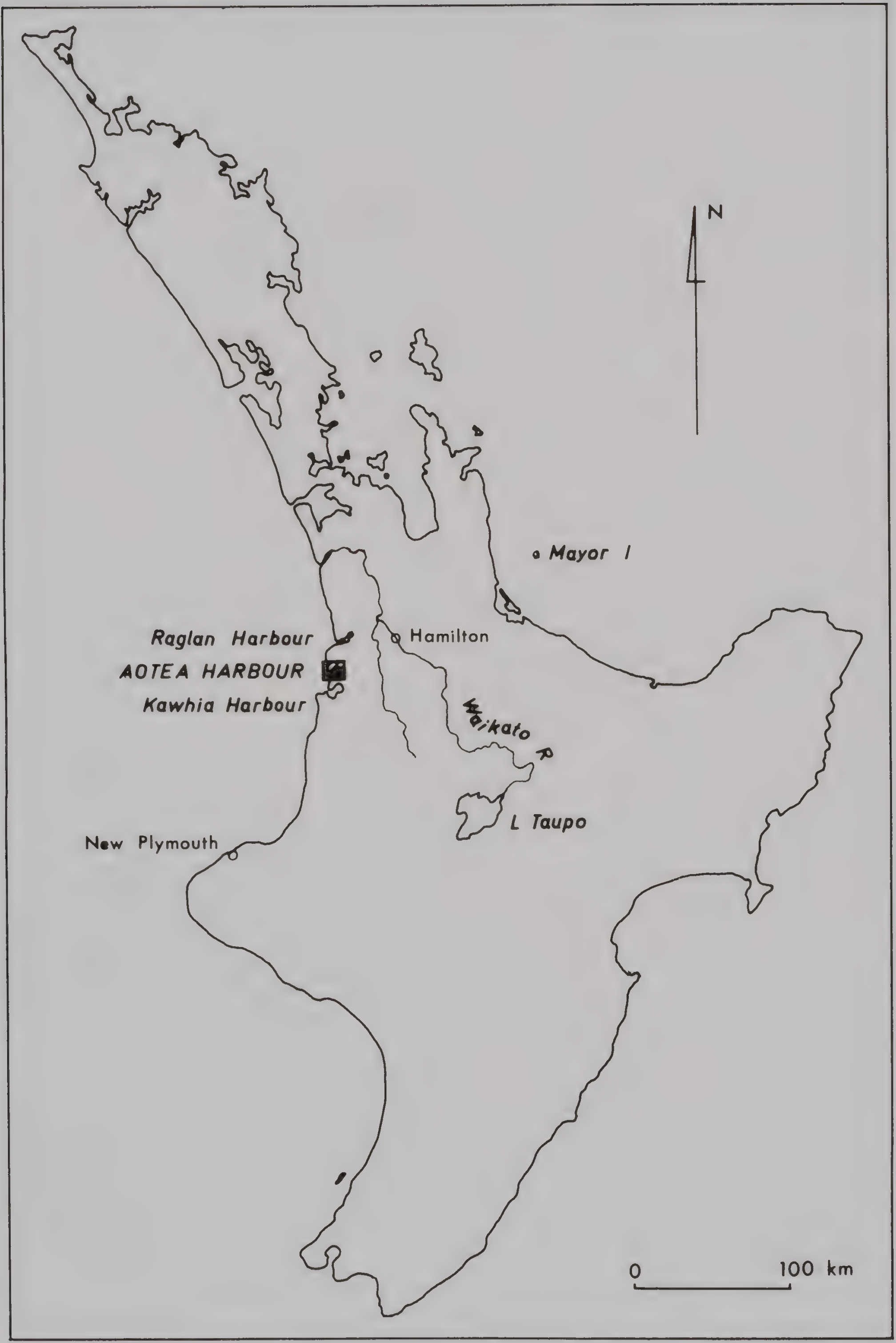


Fig. 1. Location map.

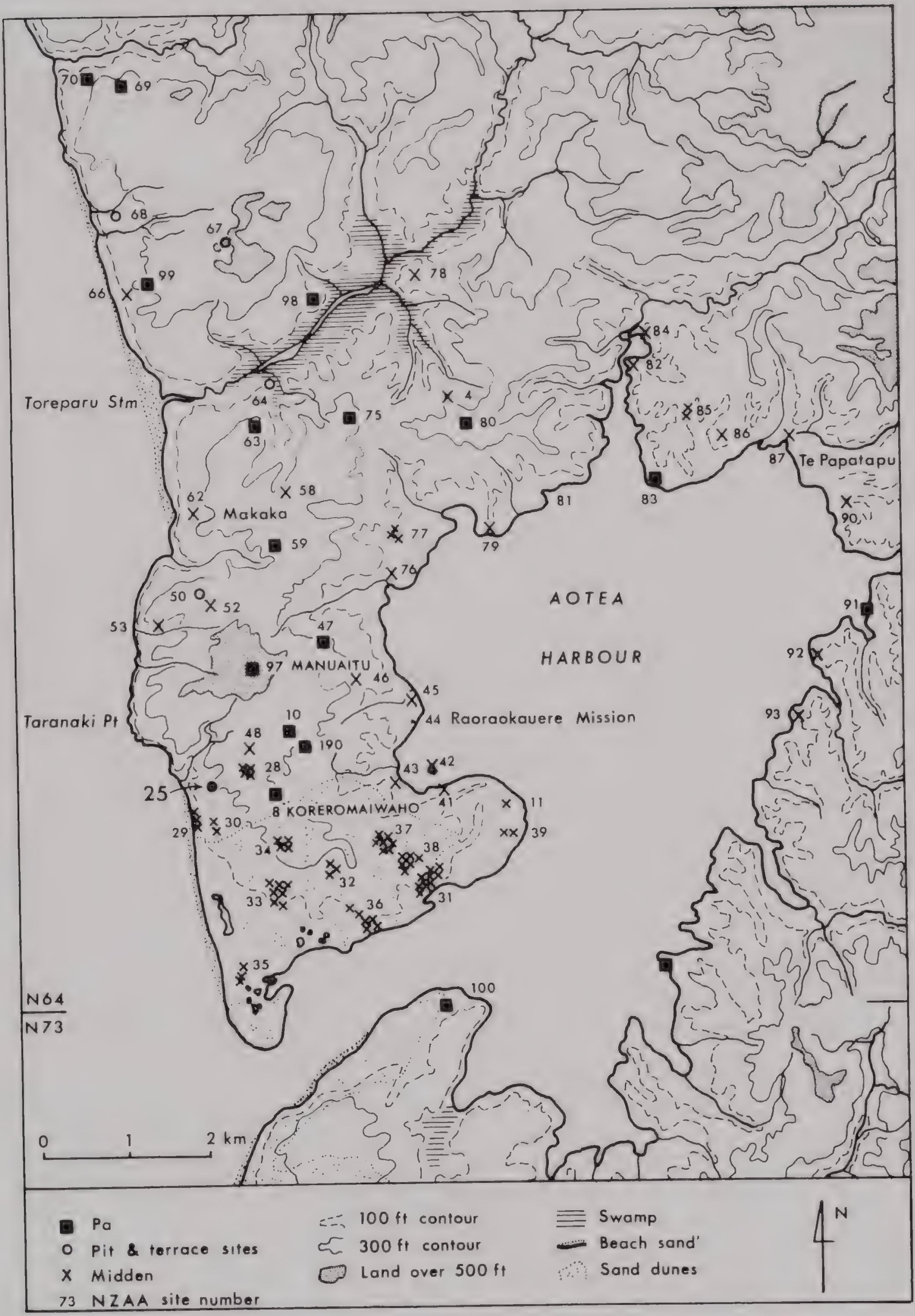


Fig. 2. Distribution of sites, Aotea North Head. For location see Fig. 1.

Geologically the area is complex: the higher ground to the north is basically Jurassic greywackes and argillites with a Tertiary cover of marine deposits of limestones and sandstones, visible in the cliffs of Raglan Harbour and about Taranaki Point, but mainly eroded elsewhere. Late Pliocene eruptions produced the basalts and andesites of Mount Karioi (716 m, 2350 ft) together with the Manuaitu dome which were subsequently mantled by Quaternary deposits of the Kaihu group, made up of andesitic tephras (Pain 1976: 158 and fig. 1). Aotea Harbour filled "a depression formed during the Miocene movements by west trending faults and associated down scarps" (ibid:155). The Head itself was built up by a marine supply of sediments of late Quaternary age consisting of wind blown (Aeolian) sands interbedded with water-laid sediments which have become consolidated to varying degrees (ibid:169). The loose surface sands are still moving north and eastwards, driven by the prevailing south-west winds and have engulfed remains of Maori occupation, including Koreromaiwaho pa (N64/8). The variety of the geological formations provided some advantages for early Maori settlers and is reflected in the stone artefacts found during the excavations (see Catalogue, Figs. 17-23).

A few small streams flow west in steep-sided valleys to the Tasman beaches, and others flow east through lowland and swamp to the shallows of the harbour. There are also small pools of freshwater formed where the dunes have built up across former drainage lines (Pain 1976:171).

The natural undisturbed soil in the tract of land between Manuaitu and the dunes where the excavations took place, is "a firm bright reddish-brown ash", an andesite tephra, covered by 5-10 cm of dark brown friable sandy loam with a weak to moderate crumb structure, the product of ancient weathering sand accretions. Walton's work (Walton MS) has shown that beneath the present turf line, the top soils were improved and deepened for Maori cultivation by the addition of fine sands dug from below the ash in numerous 'borrow pits'. Today the area is reclaimed grassland, providing a windswept pasture that is almost treeless. Scrubby growth and an occasional pohutukawa survive in the Te Puata and other small valleys, whilst a patch of scrub (now removed) close to the excavation in 1973 consisted of *Senecio* spp., *Cyathodes* and *Coprosma*. Examination of the charcoals from the excavation (Appendix 4, below) showed that there were some forest trees, tawa and rimu (11%), as well as kanuka (16%) growing in the vicinity in the late 15th and 16th century, the remainder being from shrubby growth, mainly *Hebe* sp. (23%) and *Coprosma* (7.6%). Pohutukawa was represented only in a sample from the topsoil near the site. The Maori need for house timbers, for palisades, and for firewood, as well as land clearance for cultivations, will have undoubtedly contributed to the loss of the coast forest formerly existing in this area.

Other natural resources available to early settlers in the area were the extensive beds of shellfish; at the present time there are tuatua and mussels on the Tasman coast, pipi in the sands of the harbour entrance, and cockles throughout the harbour (Cassels 1973:fig. 1). Excavation showed that all these were exploited by the Maori population. Eels would be obtainable from the streams to the harbour as well as from the Toreparu and Ruapuke streams.

Site description, N64/25 (Fig. 3)

The site chosen for excavation was a group of terraces on the south-facing slopes of a shallow dry valley and about 200 m inland from the present cliff top, which is slowly being eroded. There is another similar valley lying parallel to the south, beyond which is the present edge of the high sand dunes, about 150-200 m distant from the excavated site. The valley was selected because it was one of the few with terraced settlements surviving in the area (Fig. 2) which had not been heavily ploughed and because there were signs of cultivations as well as 'borrow pits' near by. Shell midden indicative of occupation was exposed on the outer edge of some terraces and there were surface indications of storage pits. The intention was to look for houses and other domestic structures since apart from the swamp site of Mangakaware (Bellwood 1978) none were then known in the Waikato; and in view of its potential to examine fully the economic basis of the settlement. The association of shell midden, storage pits, and possible house sites seemed to have considerable potential for a quantitative study of diet.

The visible remains of the settlement consist of some 20 terraces spread out over a kilometre of the landscape and sited from top to bottom of a gentle slope, 10 m high. The relief is slight and individual features are difficult to discern when the grass is growing strongly. The terraces tend to occur in groups with one large one 20-30 m long associated with two or three smaller ones, for example the excavated sites A1-2, and A4 (Fig. 3). To the west end of the site nearing the cliff edge, which is 70 m above sea level, there is a flat area 40 x 75 m without signs of occupation; three rectangular storage pits are visible on a large terrace below the flat, and three more on the slopes above it, measuring 6 x 3, 3 x 2 and 3 x 3 m which are not marked on Fig. 3. The top of the bell-shaped *rua* pit was visible on the highest terrace at the east end of the site, and another on the adjacent terrace (A6) which was excavated (Fig.12, Pit 10).

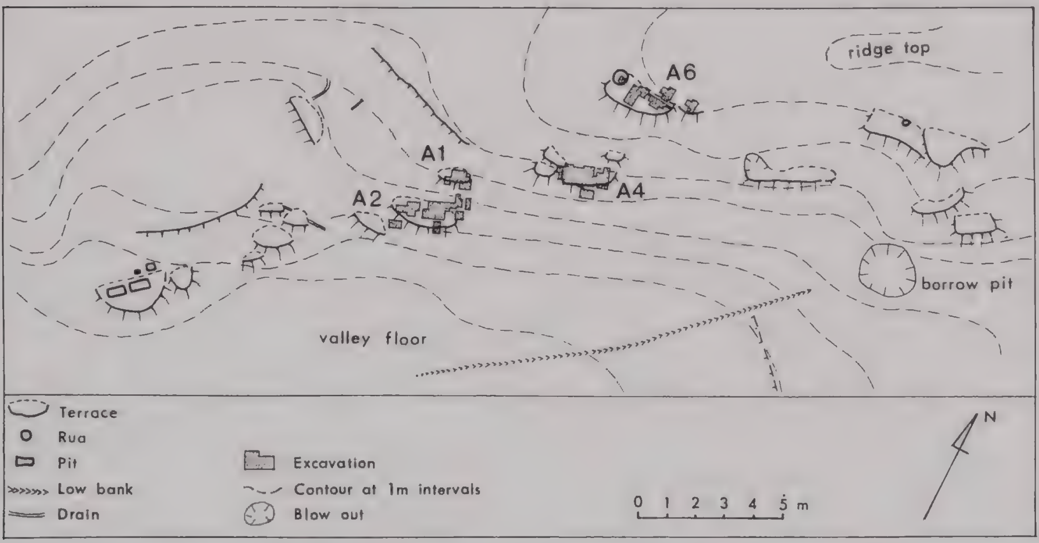


Fig. 3. N64/25. Plan of terraced settlement.

Across the valley floor there is a low transverse bank and an associated lynchet scarp at right angles to it, indicative of ancient cultivation. There is one large 'borrow pit', a circular quarry about 2 m deep, and another much smaller hole of similar character at the end of an adjacent terrace. Walton's work on similar features to the north-east (see Figs. 15-16) is summarised below.

THE EXCAVATIONS

Four terraces (A1,2,4,6) were selected for excavation, spread in a diagonal line one above the other up the valley side (Fig. 3). These will be described in numerical order. Each formed part of a group.

TERRACE A1 (Figs. 4-6)

This was a small rectangular terrace measuring 10 x 4 m dug into the hillside with a conspicuous spill of shell midden exposed at the east end on the outer slope. It was close to the larger terrace A2 and slightly above it, and with a third terrace further down the slope, which was not investigated, made up a characteristic group.

Test bores were first made to determine the extent of the midden. The midden was then excavated in 50 cm wide strips moving from the edges inwards, but leaving a set of 50 cm square blocks for sampling. This 'advancing face' method was chosen in order to reveal the stratigraphy; it enabled a ten phase sequence of shell deposition to be established. The analysis is given in Appendix 1.

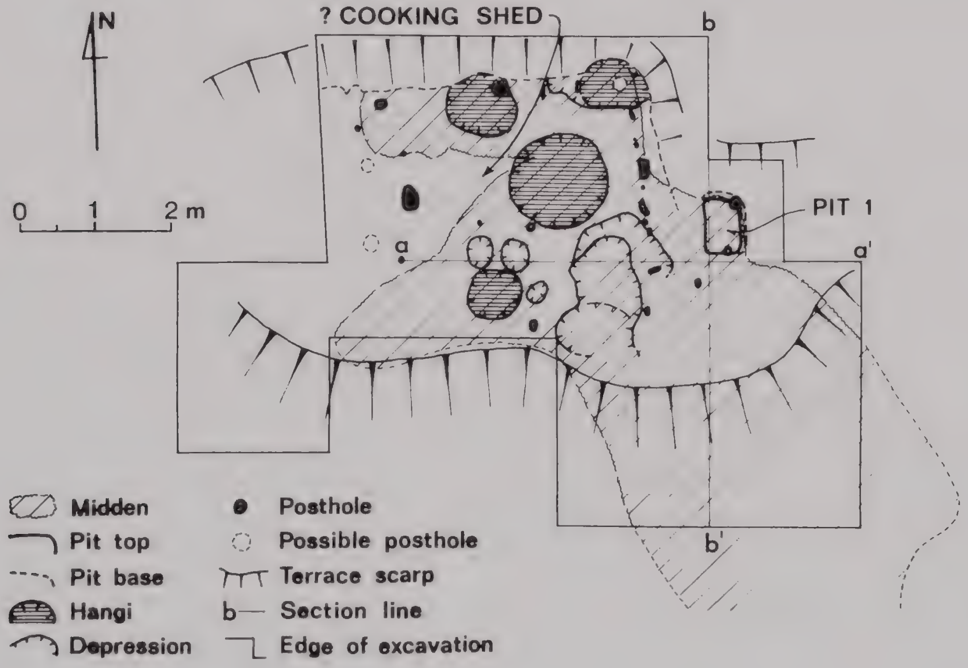


Fig. 4. Terrace A1, plan.

In general the midden was found to consist of pipi shells, with occasional lenses of cockles; it was about 30-35 cm deep, resting on a layer of brown sandy loam, the original ground surface formed on top of firm clean ash. The midden extended as a thin layer towards the centre of the terrace where it was overlaid by and mixed with pockets of charcoal, burnt stones and ash, the throw-out from a series of *hangi* (Fig. 5).

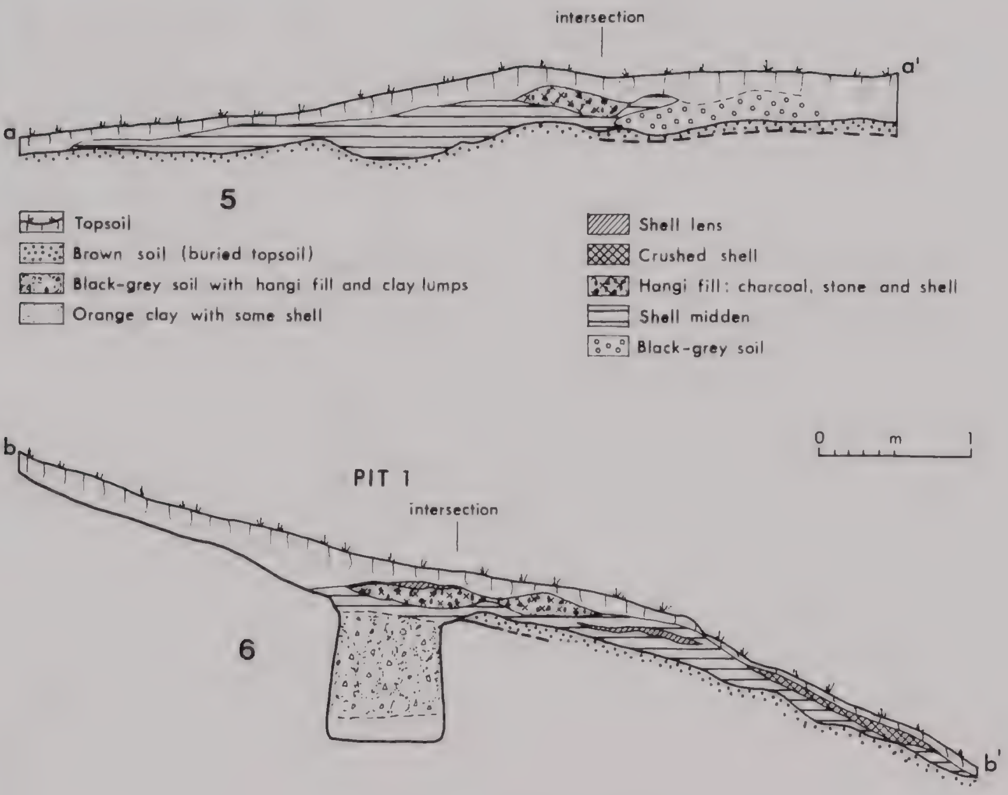
An area 5 m long by 4 m wide was then cleared from the centre of the terrace with lateral extensions to investigate special features. It was found that the area had been heavily used for cooking in circular *hangi* dug into the sandy loam to a depth of 6-12 cm. The largest, in the centre of the terrace, was 65 cm in diameter, the others 30-40 cm. Beneath the thick midden on the front of the terrace, there were other hollows (marked as depressions on Fig. 4), probably also remains of *hangi*.

On the firm ground at the back of the terrace, a series of postholes was found, indicating a rectangular timber construction measuring *ca*. 4 x 3 m. The north wall was at the foot of the scarp; one of the postholes 15 cm deep cut through a *hangi* and was visible at its base, showing that this was a secondary construction. The east wall consisted of seven small irregularly spaced holes, probably for slender uprights supporting panels of woven raupo. The intersection of the north and east walls as thus defined lay in the centre of another *hangi*, where an angle post has been conjectured on Fig. 4. The west wall line was disturbed by rabbit burrows and the two postholes shown therefore are treated as doubtful. Since no postholes could be found on the south side, the building is considered to have had an open front. Two large postholes, 45 and 26 cm deep, though they are not exactly central, indicated the position of uprights carrying a horizontal timber to support the lean-to construction (Fig. 47). No hearth or artefacts were found inside where midden continued to accumulate; probably it was a cooking shed providing shelter for the inhabitants for food preparation and at mealtimes. A small pumice disc (Fig. 30) was found south of the structure.

At the east end of the terrace there was an unusual bell-shaped pit (Pit 1), measuring 35 x 25 cm at the mouth and expanding to 50 x 35 cm at the bottom. There was a posthole at either end of the floor. It had been deliberately filled with dark soil with lumps of clay and ash from *hangi* and then covered by a layer of shell midden and more *hangi* waste (Fig. 6), indicating the pit was an early feature. Its purpose is uncertain; the excavators conjectured it was a latrine *(paepae)*, but its infilling is against this. It is more likely to have been a specialised form of cool store; food in woven baskets *(kete)* or gourds could have been suspended from a horizontal bar between the two posts, and the opening covered by a wooden slab. Two perforated pipi shells (Figs. 27, 28) were found in the midden around the pit.

Chronology

The construction sequence on the terrace appears to be as follows; in the first phase, there was the construction of the terrace, the digging of Pit 1, and the use of the back and centre of the terrace for the *hangi*. In the second phase, the pit was filled up with *hangi* debris and an open fronted wooden cooking shed was constructed at the back of the terrace superimposed on two of the *hangi*. Much shell midden and some *hangi* material were deposited at the east end of the terrace, covering the mouth of Pit 1 and spilling down the lower scarp towards Terrace A2. No date was obtained for either phase.


intersection
a
a'
5
Topsoil
Brown soil (buried topsoil)
Black-grey soil with hangi fill and clay lumps
Orange clay with some shell
Shell lens
Crushed shell
Hangi fill: charcoal, stone and shell
Shell midden
Black-grey soil
0 m 1
b
PIT 1
intersection
6
b'

Figs. 5,6. Terrace A1, sections.

TERRACE A2 (Figs. 7-9)

This was a large terrace close to and below A1; it measured 22 m long and 6-8 m wide; some midden was exposed midway along the lower scarp. When excavated it was found to contain four rectangular pits (2-5 on plan), each with the long axis parallel to the terrace, and a working place associated with the midden but no house structure. Together with another small pit (Pit 6) on a flat 2.5 m away to the south-east (see Fig. 8), it can be deduced that this was the storage place for the owners of the terrace A1 above.

The largest pit, Pit 2, was at the west end of the terrace at the foot of the back scarp; it measured 8 x 2.5 m and was 45 cm deep, cut in the firm orange ash. The lower layers of the filling were of clean yellow soil which had slipped in from the upper side; these were covered by a 20 cm thick layer of dark soil and charcoal and by another of brown soil, representing a deliberate infilling when the pit was no longer used (Fig. 9, Section a). Finds from the filling were an obsidian core (Fig. 19) and a piece of siliceous sinter, a stone polisher (Fig. 36), and three pumice objects, a head and a crudely carved face and a stopper for a gourd (Figs. 32-34). A broken adze blade of imported South Island argillite was found at the top of the filling (Fig. 17). A series of small postholes, 10-20 cm deep in the centre of the pit floor indicated that this long pit was roofed, with a ridge pole carried on at least four supports in the deeper holes. Alternatively the excavators thought it might have been an aisled construction with a cantilevered support for the rafters resting on two rows of side posts (Fox 1974:144, fig. 2). Unfortunately insufficient of the pit floor was uncovered to find more than one posthole in a possible second side row. Duplication of some central postholes indicates that the pit had been re-roofed. Other features were three small depressions in the south-west corner of the pit, and a hollow in the south-east corner undercut in the manner of a *rua*. There was a rectangular setting of five postholes on the terrace 40 cm away from the pit edge; these may have held posts to secure the ends of the rafters and to prevent the south-west corner of the roof lifting in the prevailing strong westerly sea winds.

Pit 3 was in the centre of the terrace; it measured 3.2 x 1.5 m and was 75 cm deep, with a firm floor of consolidated ash and sandstone. There were three postholes forming a central row for timber uprights to support a ridge pole for the roof. The lowest layer of the filling was a natural accumulation of "reddish-yellow gritty clay" (ash), which had slipped from the sides, covered by a deliberate infilling of "brown soil flecked with charcoal" sealed down by a thick layer of clean yellow soil in which a seam of charcoal was conspicuous in the cross-section (Fig. 9). The clean soil for infilling was probably obtained from the digging of another pit. One curious feature was noticed in this pit and the nearby Pit 4. Along the upper part of the pit sides, there were slots filled with sandy brown soil, 20-30 cm deep and in some cases continuing to the pit floor (Fig. 8). This was at first thought to be the remains of a lining of plank-like timbers, perhaps split *ponga*, to prevent slips from the pit sides where it was dug in sandy soil. This seems very reasonable and has analogies elsewhere in Auckland and the Bay of Plenty (Fox 1974:149). However, it was concluded later that the slot was the result of the filling not being properly consolidated; consequently soil had slumped inwards from the pit sides creating a space, which subsequently was filled by blown sand and humus.

Pit 4 was dug at the back of the terrace; it measured 3.2 x 2.5 m and 65 cm deep. A cross section (Fig. 7) showed that the terrace had been built up on the lower side, with successive layers of grey ash and yellow mixed soil with lenses of black soil in places, to a height of 40 cm. The pattern of postholes in the hard reddish ash of the pit floor indicated a central ridge pole supported on two uprights, with others perhaps marking divisions at the sides similar to those in Pit 2. The pit filling revealed some secondary use; after 40 cm of

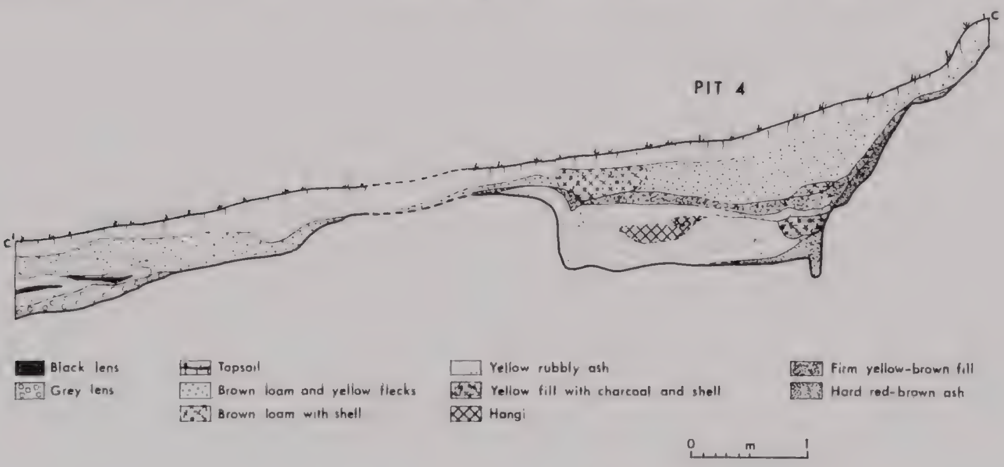


Fig. 7. Terrace A2, section.

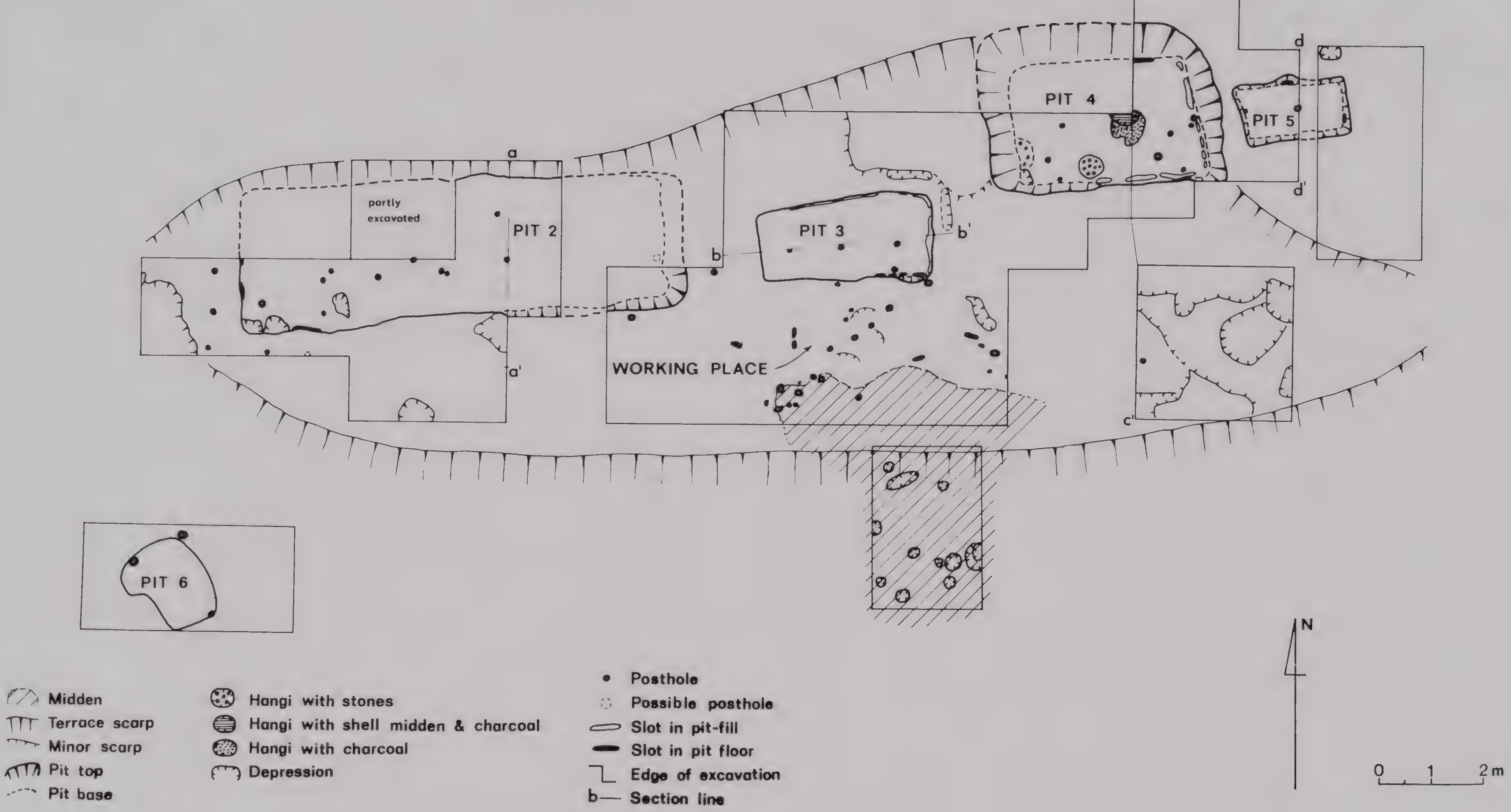
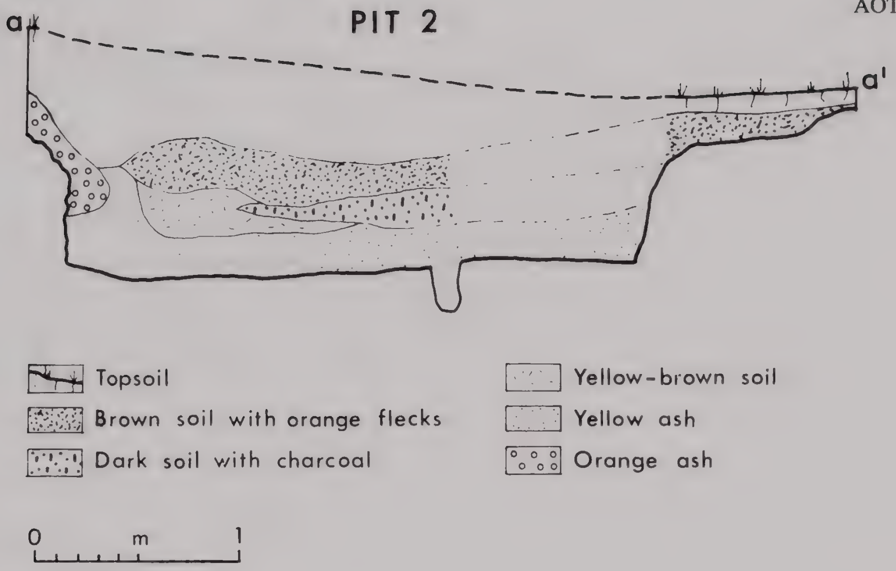
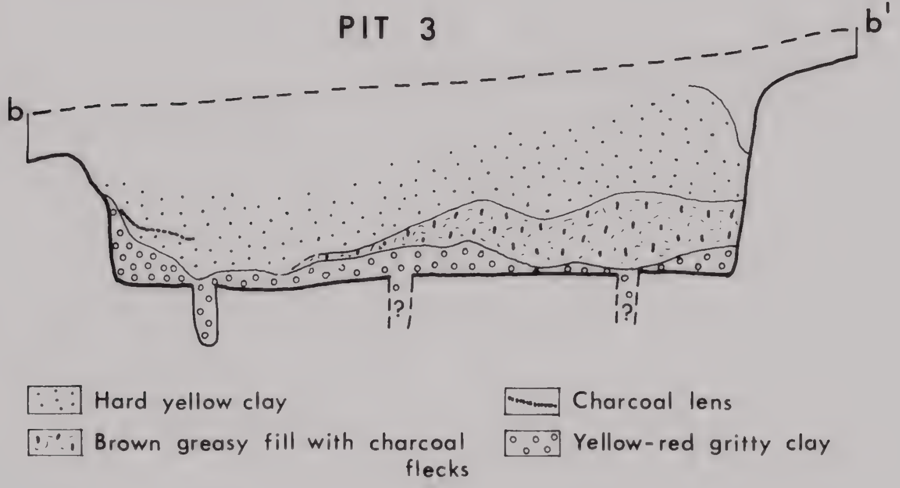


Fig. 8. Terrace A2, plan.





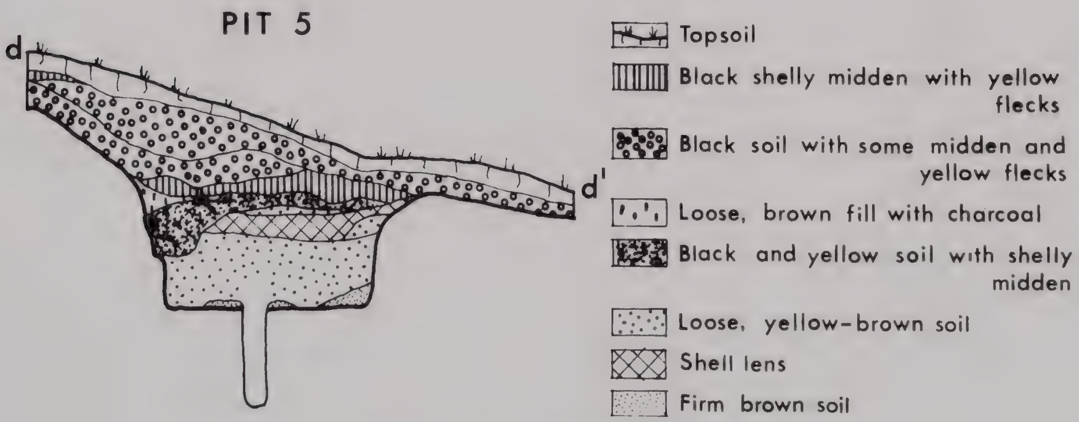

PIT 5
d
d'
Topsoil
Black shelly midden with yellow flecks
Black soil with some midden and yellow flecks
Loose, brown fill with charcoal
Black and yellow soil with shelly midden
Loose, yellow-brown soil
Shell lens
Firm brown soil

Fig. 9. Terrace A2, sections.

"soft yellowish rubbly soil" had slumped into the pit, cooking had taken place in the shelter of the hollow. In the centre there were two hearths, one above the other with much ash and charcoal, and some shell midden in the upper example. Two *hangi* at the south end of the pit retained their original filling of heated stones. An obsidian blade (Fig. 20) and a pebble pounder were also found at this level. A series of slots were recorded in the upper part of the pit filling along the east and south sides. It is clear from the section (Fig. 7) that there was a quantity of slip from the nearby back scarp of the terrace, which covered the cooking place to a depth of 40 cm. This favours the suggestion that the slots had held a plank revetment (protecting the cooking place) which probably had been removed when the terrace was abandoned, resulting in a run of soil followed by hill wash from above.

Pit 5 was separated from the main terrace, being placed on sloping ground above the scarp. It measured 1.4-0.8 m and 58 cm deep. It had only two central postholes for the supports of a ridge pole, none at the east end where the entrance may have been situated. The centre post was driven 25 cm into the natural soil (Fig. 9). The primary filling was a natural accumulation of "yellow brown rubbly soil" 30 cm deep which had fallen from the sides. This was covered by four successive layers of shell midden separated by bands of yellow and black soil. A possible posthole or side slot was detected cut into the primary deposits and subsequently filled with midden. There were no signs of a secondary occupation in this pit; all the midden layers appear to have been thrown down or slipped from the hillside above until the pit overflowed; their source was almost certainly Terrace Al above. A small greenstone fragment was found in the pit filling, possibly from a chisel.

There was another detached pit (Pit 6) at the south-west end of the terrace 2.5 m below the scarp on flat ground. It was an irregular kidney-shape 1.65 x 1.75 m and 50 cm deep, with the sides slightly undercut. There were three postholes in the angles suggesting a tripod-like construction, perhaps for suspension of food in containers as in Pit 1. Details of the pit filling were not recorded.

The three pits, 2, 3 and 4, took up most of the available space leaving only a narrow strip on the front of the terrace. Excavations here showed a series of small postholes, and a spread of ash and shell midden as well as shallow depressions and levellings in the made ground. No major structures were evident but irregular settings of posts suggest that screens or little shelters may have been erected. A triangular setting of three posts may have been supports for a drying rack, similar to those shown in the deserted Kahouwera pa, Bay of Islands, drawn in 1827 (Fox 1976:fig. 2). Although no hearths were found, the spread of ash and midden showed that the preparation or cooking of shellfish had taken place near by, similar to that in the disused Pit 4. It is therefore likely that this was a working place where people sat sheltered from the wind and prepared kumara and other products for pit storage or for drying or cooking. A bone fishhook fragment (Fig. 26), a basalt pebble tool and some pumice fragments were found here.

Chronology

It is clear that there were two phases of occupation of the terrace; in the first, three pits were dug on the firm ground at the back and were roofed; there is no evidence to prove or to disprove that these were contemporary or successive constructions. In the second phase, one pit, Pit 4, was disused and soil slipped into it to a depth of 40 cm: two stone-filled *hangi* and hearths were then made in the shelter of the half-filled pit, which was revetted with slabs at the sides and used for cooking in conjunction with the working place at the edge of the terrace, where shell midden was deposited. The other three pits, 2, 5 and 6, probably continued in use until the terrace was abandoned. No carbon samples were taken.

TERRACE A4 (Figs. 10,11)

This was a large terrace above and to the east of A1: there were three small terraces adjoining it, each with the surface indication of a rectangular storage pit (Fig. 3). Only the large terrace A4 was excavated; it measured 17 x 6 m and proved to have a complicated history. The features will be described in order from west to east.

At the west end of the terrace a series of postholes indicated that there was a small house built at the foot of the scarp, with a porch or verandah facing east on to an open space. There was a deep bin pit, Pit 9, 72 x 55 cm and 85 cm deep, on the edge of the terrace beside it. The house structure is problematical; the front wall is well defined by a line of three postholes, completed by a fourth at the north-east angle where a 'depression' was recorded. The northern side wall, at the foot of the scarp, was obscured by a rabbit burrow, but the line of the back wall was established from three postholes with another post conjectured at the south-west angle, which however was not identified at the time of excavation. The overall dimensions thus obtained are 2.25 x 1.9 m; in addition, a porch 0.85 m deep is indicated at the east end by two postholes 1.5 m apart. The house floor had been disturbed by a rabbit burrow and no hearth was found. It is possible that a depression in the centre of the porch had been a warming place, on the analogy of similarly placed hollows found filled with heated stones in several houses at Pouerua, Bay of Islands in Sutton's 1983 excavations. Inside the house, a line of three close set postholes indicated the position of timber uprights carrying the ridge pole. Since these are off-centre, it can be conjectured that the rafters on the north side were carried over the wall line for the ends to rest on the terrace scarp (see reconstruction, Fig. 47); alternatively, that the roof was of a different pitch on either side of the ridge. Double postholes, one in the front wall and one in the porch, indicate that two posts had been replaced. Similarly some of the internal ridge supports may be replacements because the number seems superfluous in such a small house. Finds from the house were a bone fishhook (Fig. 25), a stone file (Fig. 23), and an obsidian blade (Fig. 18) and four flakes.

In front of the house there was an open space, extending right across the terrace. Two isolated postholes 1.3 m apart suggest a drying rack aligned so as to face the prevailing westerly winds. Beyond this, the centre of the terrace was honeycombed by a series of small hollows or depressions, interspersed with groups of postholes and stake-holes from which no obvious structure could be detected. Like the similar remains on Terrace A2, this was probably a domestic working place where people sat preparing fish, shellfish, kumara and other food for cooking in the *hangi,* or for drying or storing. A pumice abrader (Fig. 38), a sinker (Fig. 37), a pebble pounder, as well as five flakes of obsidian and one of chert were found here and suggest that some manufacture also took place. At the edge of the terrace there was an extensive shell midden which continued over the scarp (Appendix 2).

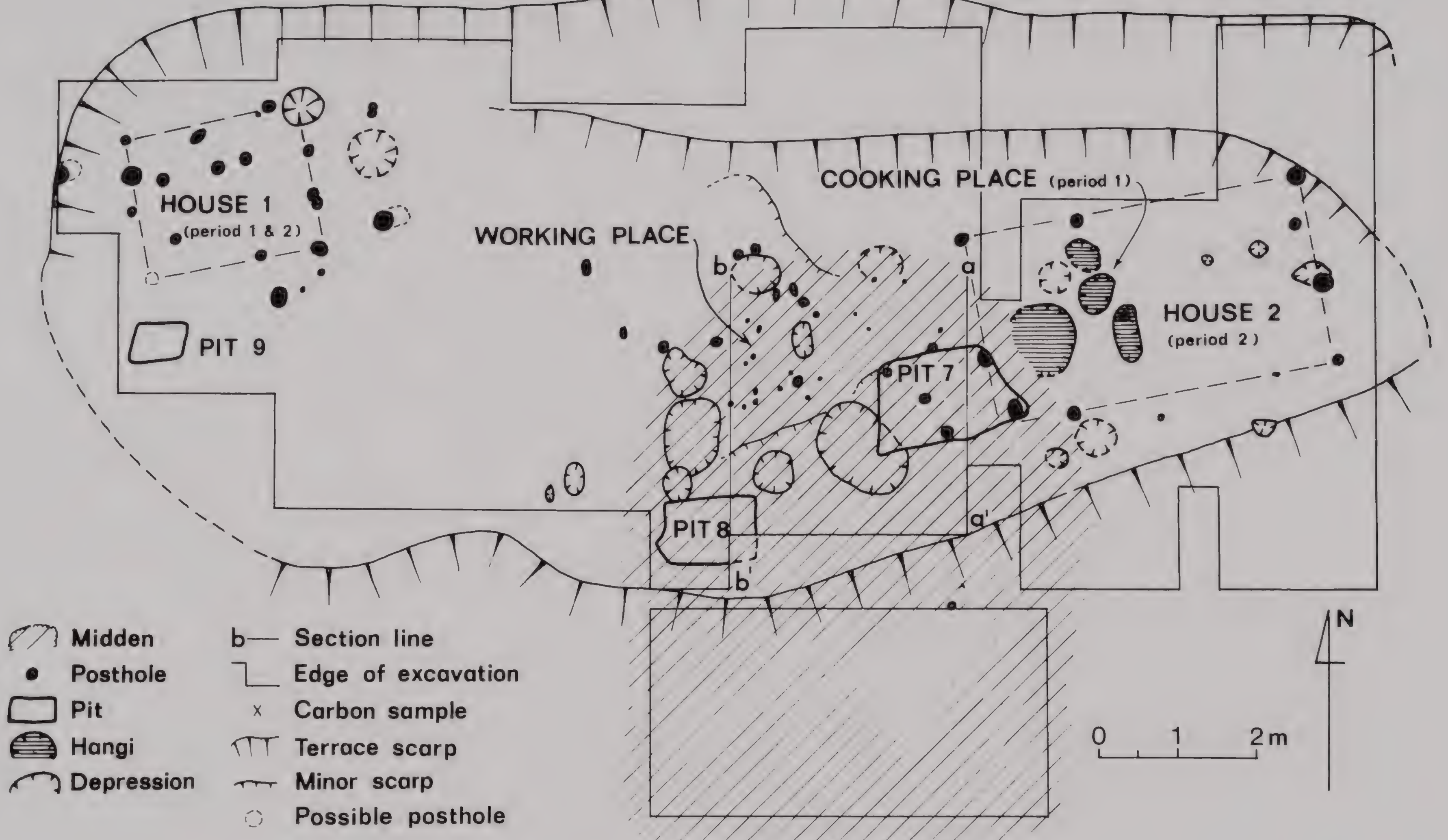


Fig. 10. Terrace A4, plan.

Shells from the lower layers yielded a radiocarbon date of 430 BP ± 50 (A.D. 1520), others from a higher layer 390 ± 50 B.P. (A.D. 1560) (see Appendix 3). Beneath the midden there were two small pits, Pit 7 and 8, which had been filled in previously. Pit 8 measured 1.20 x 0.80 m and was 90 cm deep; it had been cut through layers of 'brown greasy soil' and clean orange soil (redeposited ash) which made up the base of the terrace. The pit was filled with layers of midden of differing consistency, but mainly burnt shells, charcoal and wood ash from *hangi* (Fig. 11, Section b). A sample of charcoal from the bottom of the pit produced a corrected radiocarbon date of 440 BP ± 40 (A.D. 1510). The second small pit, Pit 7, measured 1.80 x 1.05 m and 85 cm deep and had been cut through part of a 'depression' (Fig. 10.) It was an irregular shape when excavated, probably because parts of the sides had fallen away when two postholes belonging to the later House 2 had been inserted into the filling at the east end. The pit was filled with dark brown soil and shell, and like Pit 8 was covered by the later midden (Fig. 11, Section a). There were three postholes on the floor, one central, two at the sides, showing that the pit had been roofed, and probably revetted at the sides. A bone fishhook point was found in the filling (Fig. 24).

Close to the pit at the east end of the terrace, there was a cooking place with at least four *hangi*, each placed in a shallow oval depression 6-12 cm deep, containing ash and charcoal. One of them had been cut y a posthole 25 cm deep extending down from the layer above. Other postholes 10-18 cm deep outside the cooking area indicated two sides of a rectangular structure, 4.4 m long by 2.5 m wide. The outline was completed by the two postholes 16 cm deep found in the filling of Pit 7 and by another 17 cm deep in the made ground near the edge of the terrace. The single post which penetrated the *hangi* is central to the structure and is likely to have been a support for a ridge pole and implies that the building was roofed (Fig. 10). There was no evidence of its function; it could have been a second sleeping house *(whare)* or a store *(pataka)*. It is clear that it was the latest construction on the terrace. A small pumice cup (Fig. 29) and a sandstone file (Fig. 22) were found.

Chronology

Three phases of occupation are apparent on this terrace. The first consisted of the building of the small House 1 with a bin (Pit 9) nearby, the use of the working place for domestic activities, and the cooking place with group of *hangi*. In the second phase, Pits 7 and 8 were dug, cutting into existing hollows (depressions) in the working place. Pit 8 was subsequently filled up with midden probably from the cooking place and yielded a corrected radiocarbon date of A.D. 1510 ± 40 from the lowest layer. A quantity of shell midden continued to be produced and was deposited on top of the filled-in pits and strewn down the terrace slope; samples of shells produced two radiocarbon dates of A.D. 1520 ± 50 and 1560 ± 50. In the third phase a rectangular timber structure was erected on top of the cooking place: one of its postholes cut into a *hangi* and two others were inserted in the filling of Pit 7, belonging to phase 2.

The three radiocarbon dates show that phase 2 can be dated within the time span of A.D. 1460-1610, and most probably during the first half of the 16th century.

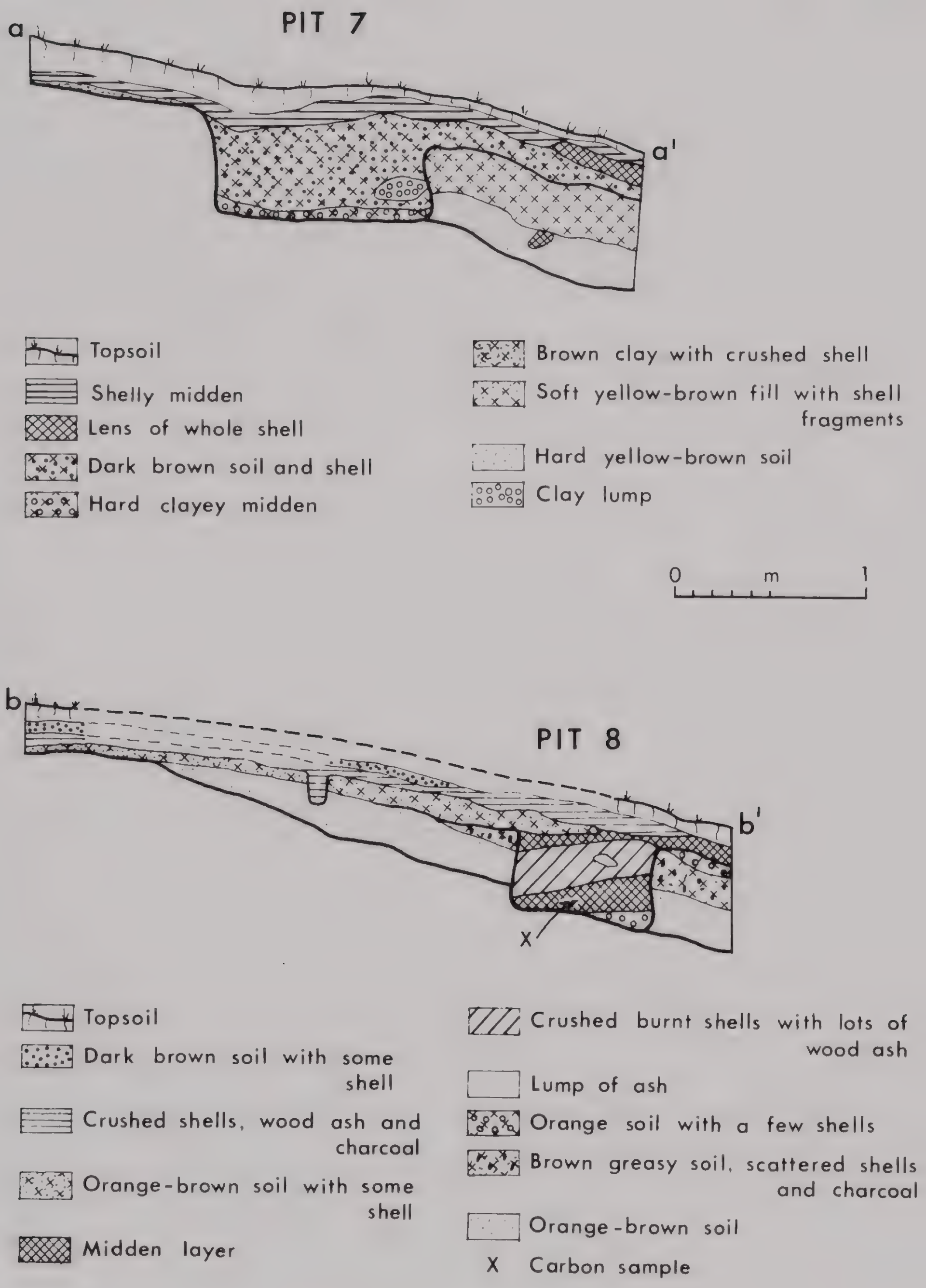

PIT 7
a
a'
Topsoil
Shelly midden
Lens of whole shell
Dark brown soil and shell
Hard clayey midden
Brown clay with crushed shell
Soft yellow-brown fill with shell fragments
Hard yellow-brown soil
Clay lump
0 m 1
b
PIT 8
b'
X
Topsoil
Dark brown soil with some shell
Crushed shells, wood ash and charcoal
Orange-brown soil with some shell
Midden layer
Crushed burnt shells with lots of wood ash
Lump of ash
Orange soil with a few shells
Brown greasy soil, scattered shells and charcoal
Orange-brown soil
X Carbon sample

Fig. 11. Terrace A4, sections.

TERRACE A6 (Figs. 12-14).

This was a long narrow terrace measuring 23 x 5 m situated at the top of the slope, with two small satellite terraces above and to the east of it, one originally designated A5. Like terrace A2 it was an area for pit storage. Excavation was limited to investigating the six pits, and to uncovering sufficient of the remaining space to show that there was no house or other structure present.

At the west end of the terrace immediately below the scarp, there was a pit, Pit 10, cut in the natural sandstone to a depth of 1 m. The sides had been undercut in places and the irregular shape is probably due to the difficulties of cutting in the rock. No postholes were found in the floor and its storage capacity must have been limited; it probably was designed for a special need. The section (Fig. 13) shows that only a thin layer of sandy soil had accumulated on the floor before it was filled in by layers of dark brown and black greasy soil containing a sandstone rubber (Fig. 31) as well as pieces of broken sandstone from the sides. These were covered by a layer of brown soil, probably a natural accumulation of humus and wind-blown soil, after the terrace was deserted.

A much larger pit was Pit 11, a long narrow pit measuring 6.7 x 1.8 m and 70 cm deep. A central line of five postholes 25 to 33 cm deep, including one replacement, indicates the position of supports for a ridge pole. Two other postholes, 43 and 36 cm deep, may have held additional supports on the south side of the ridge; there were also several small stake holes, 8 to 10 cm deep. Another feature was a deep rectangular slot on the northern side of the floor, perhaps a bin rather than a drainage sump. The entrance to the pit was probably by way of a shallow recess in the south side. A section (Fig. 14) showed that the pit had been filled with yellowish-brown earth to a depth of 50 cm, covered subsequently by slips of cleaner soil from the terrace scarp and by a natural accumulation of dark brown humic soil, forming the present surface. A scraper of siliceous sinter (Fig. 21) came from the filling of this pit.

In the space between Pits 10 and 11 there was a small pit, 15, at the back of the terrace; it measured 2.25 x 0.85 m and was only 30 cm deep. It seemed to have filled up naturally, first with a slip of light brown soil with charcoal from the sides and then covered by the usual humic brown soil, here washed down from the terrace scarp behind the pit (Fig. 13, Section b). In the surrounding flat area, which was only partly cleared, there were a few small postholes and shallow depressions but no hearths, *hangi* or shell midden. A few pieces of obsidian were found in the surface soil.

On the small terrace north of and above Pit 11, there were the two pits, 12 and 13. Pit 12 measured 2.6 x 1.8 m and 1.25 m deep; it had a central row of three postholes for the roof supports. Pit 13 was a shallow bin pit, 1.4 x 0.85 m and only 30 cm deep; it is small enough to have had a wooden cover. It seems to have been partly cut away when Pit 11 was dug (Fig. 14). Both pits had a filling of yellowish brown soil covered by a thick layer of dark brown humic soil washed down from the hillside above into the hollow of Pit 12 and thinning out over Pit 13 (Fig. 14). The sixth pit, Pit 14, on the satellite terrace to the east, was 2.6 x 1.2 m and 70 cm deep. Only the eastern half was completely excavated, revealing two postholes for ridge supports on the central axis: a third may be conjectured at the west end, by analogy with Pit 12. A section (Fig. 13) showed an initial slip of yellow soil from the side, covered by dark brown soil with charcoal, and like Pit 12, a final layer of humic soil washed down from above.

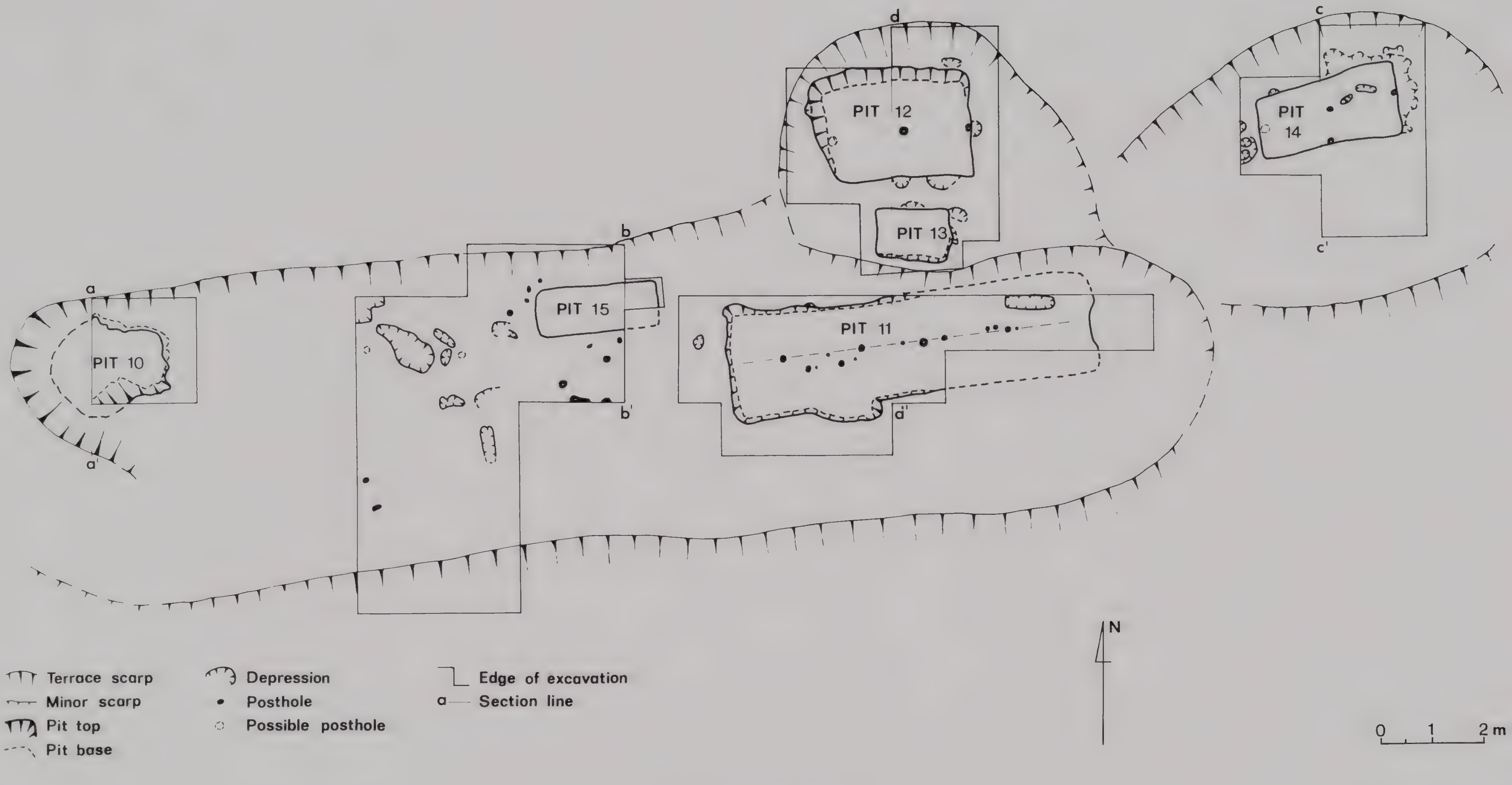


Fig. 12. Terrace A6, plan.

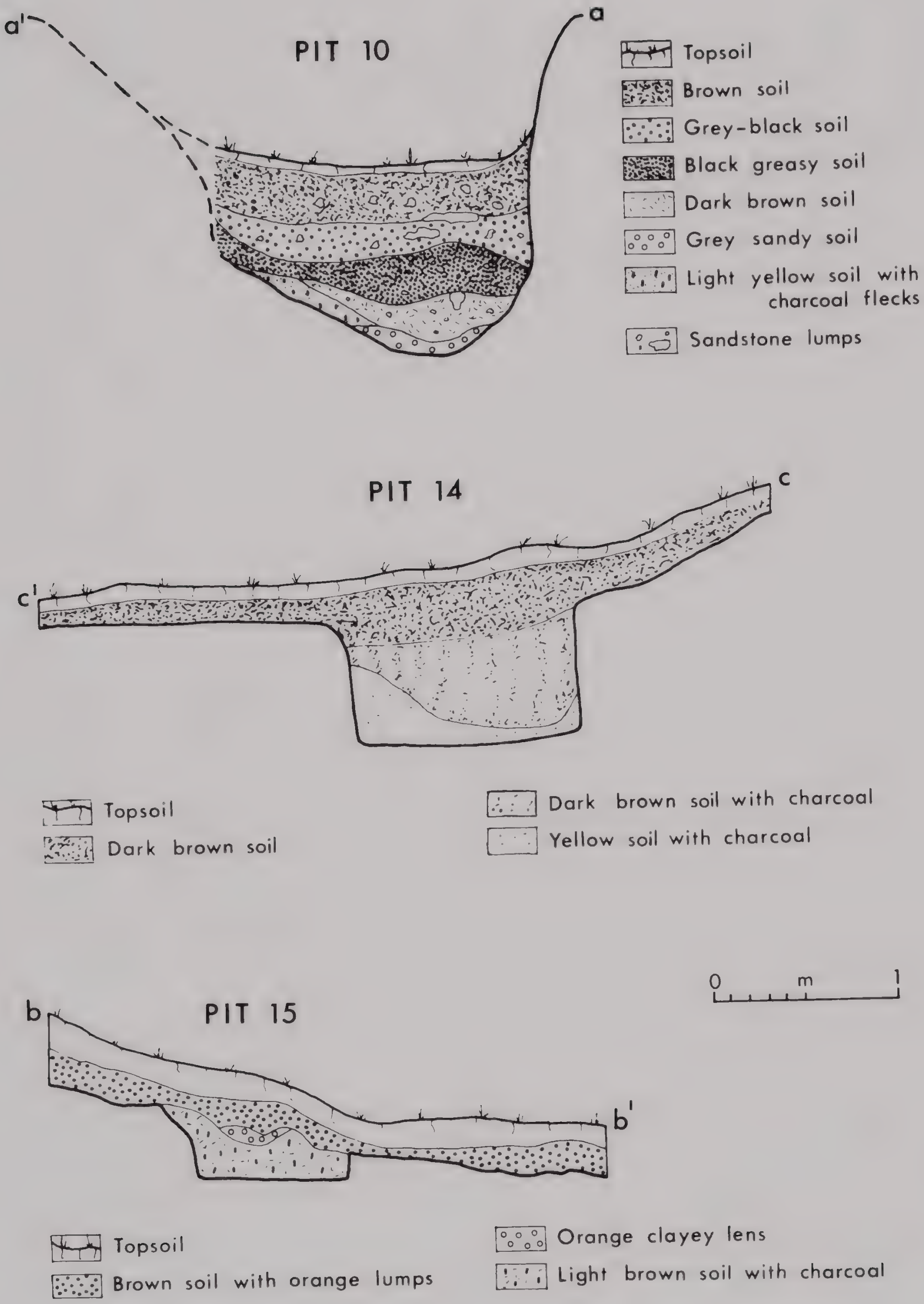


Fig. 13. Terrace A6, sections.

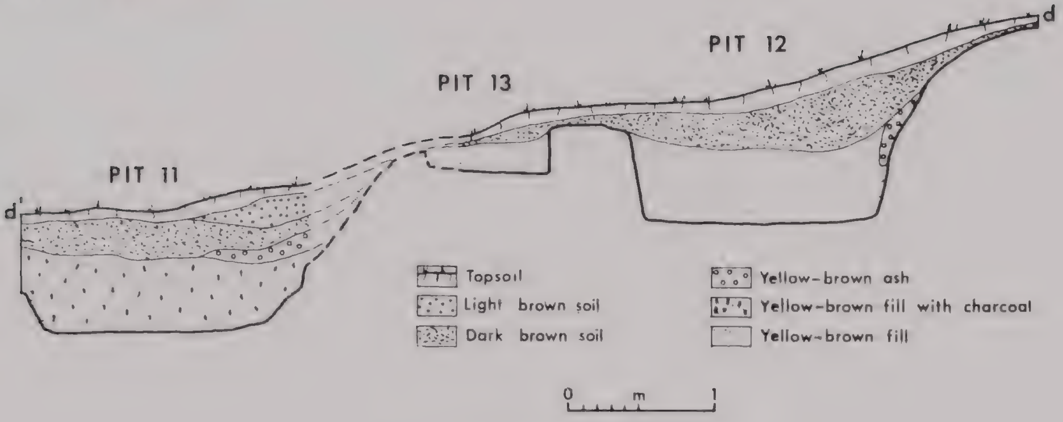


Fig. 14. Terrace A6, section.

Chronology

No dating evidence was obtained but the regular layout of the pits and the uniform construction indicate that these are all of one period. Pit 10 was deliberately filled, the others were filled up by the natural forces of erosion, slip and hill wash.

MAORI CULTIVATION, MADE SOILS AND BORROW PITS (Figs. 15-16)

At Cassels' suggestion, a systematic study of the borrow pits south of Manuaitu pa was carried out by Tony Walton; relevant parts of his work and some original illustrations are included in this report (Figs. 15-16). There are approximately 105 'borrow pits' in the whole area; they appear as circular or irregularly shaped sinkages, 5 to 30 m in diameter and from 7 to 3 m deep, which show up well on air photographs. The distribution shows that most occur in the vicinity of the small pa N64/10 Pukerewiti and N64/190 now both destroyed, and of terrace and pit sites, such as N64/25 of this report. Like the settlements, the pits are situated on the flanks of the low ridges and only exceptionally in the shallow valleys. Some of the pits are thought to be of natural origin, starting as a sinkage deepened by wind erosion. Walton demonstrated that the majority are man-made and were cut into the sides of the ridges in the manner of an adit, showing "a characteristic high face on the up-slope of the pit"; there are also shaft pits with sides of near even height. The locations were chosen where the natural cover of tephra (ash) was thin and there was relatively easy access to the underlying sand.

Test excavations were carried out in five pits situated between the settlement N64/25 and the former pa Pukerewiti: these are marked a-e on Fig. 15 and were recorded as site N64/191. The reconstructed section dug across Pit e (Fig. 16) showed that it had been cut through a 30 cm layer of ash to reach the sand substratum and continued to a depth of 3 m. The pit floor was covered by an infilling of redeposited ash, and by loose sand, which had slipped in from the sides; a thin lens of shell midden indicated a temporary stabilised surface. The other test holes in the centres of Pits a-d showed that each had been dug to the sand substratum at depths varying from 0.80 to 1.5 m below the present surface (Fig. 16). Layers of shell midden or of charcoal in the natural accumulation of loose sand filling the quarry indicated subsequent human activity and the use of the hollow for minor rubbish disposal. A sample of shells from the midden in the filling of Pit b was dated by radiocarbon analysis to 420 B.P. ± 40 (A.D. 1530), which is practically the same as the dates obtained from midden on Terrace A4 (Appendix 3). It was thus clearly established that the borrow pits were ancient sand quarries, dug and used at the same time as the main settlement was occupied in the early 16th century (Walton 1983).

There is however another specialised use for sand in kumara cultivation that seems to have passed unnoticed, namely its use in seed beds for sprouting the parent tubers before these were divided and planted out. The late Mr Eruera Stirling has given a vivid account of the practice near East Cape by his mother, the formidable Mihikotukutuku in the 1890s.

> "My mother was a real expert . . . She grew an acre of kumara on the same patch of ground every year near the old homestead at Raukokore and she stored the tubers in a pit called *Te Rua kumara a Te Ao-o-tata*, dug by my great-grandfather Te Ao-o-tata. After each harvest Mum selected seed tubers from the best kumara, nice shaped ones with plenty of eyes and she stored them to one side of the pit. She watched the moon and at the right time, near the end of August, she'd prepare the seed bed, always in the same place. She laid the kumara on the bed side by side, then she'd get good clean sand from the beach and cover them over. After that some fine grass was cut and put on top, then Mum buried the bed with fine soil and put a bit of gravel over it. The sand gave warmth to the kumara and they'd shoot out quickly. ... Within a month all of the shoots were sprouting out of the ground and Mum would start watching the moon for the right planting day." (Stirling & Salmond 1980:102)

It is clear from this account that the functions of sand and gravel were distinct and well recognised: sand is commonly used today by horticulturists for striking cuttings. Obviously there can be no evidence that such seed beds were made in Aotea in the 16th century, even perhaps in some of the borrow pits, but the possibility should be borne in mind.

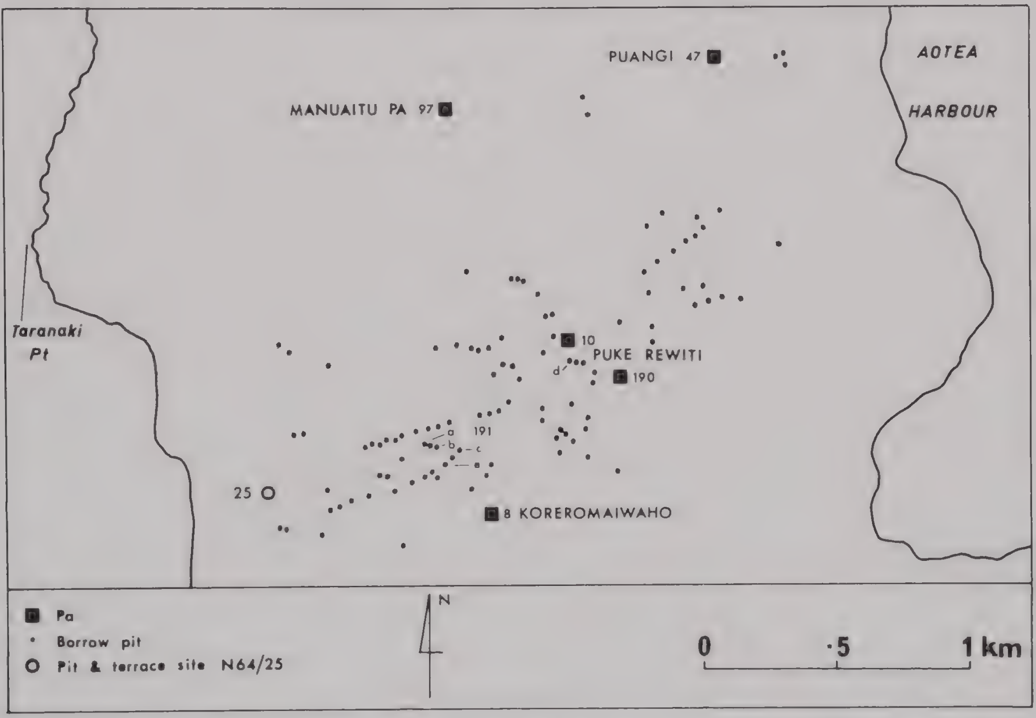


Fig. 15. Distribution of borrow pits near N64/25. For location see Fig. 2. (After Walton MS.).

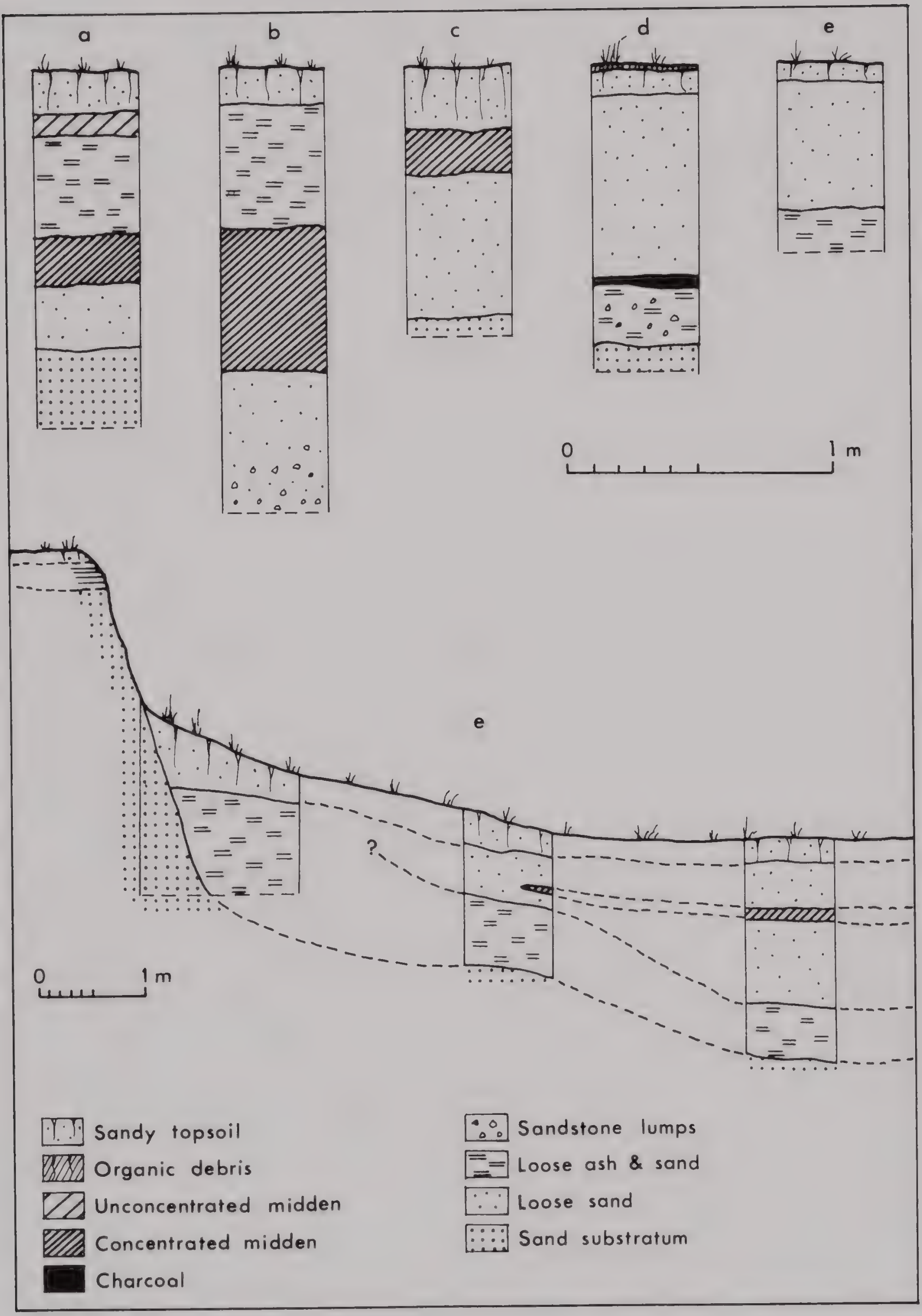


Fig. 16. Sections of the filling of N64/191 borrow pits a-e. For location, see Fig. 15. (After Walton MS.).

CATALOGUE OF FINDS (Figs. 17-38)

All the finds and a manuscript catalogue have been deposited in the Waikato Art Museum, Hamilton. Geological identifications were made by Dr Grant-Mackie and colleagues at the Geology Department, University of Auckland.

Adze blade (Fig. 17), broken, metasomatised argillite, dense grey polished surface with dark veining characteristic of the Ohana quarries, D'Urville Island. The cutting edge is worn: insufficient remains for a cross section, but it is not an early type. Compare a similar small specimen from Maioro (Fox and Green 1982:Fig. 16 and p.72) which was imported likewise probably in the 15th or 16th century. A2. Layer 1. At top of filling of Pit 2, S.E. corner. Catalogue No. 1.

Obsidian blade (Fig. 18), a flake tool with cutting edge and tip serrated by use and back steepened by secondary working (retouched). Material from Mayor Island. A4. House 1, layer 1. Cat.No. 44.

Obsidian core (Fig. 19), a thick flake from which a series of small flakes have been detached on either side; indications of use on two edges. Material from Mayor Island. A2. Pit 2, filling layer 2. Cat.No. 45.

Obsidian flake (Fig. 20), with some use at base of blade. Material from Mayor Island. A2. Pit 4, surface. Cat.No. 46.

Flake tool (Fig. 21), of pinkish siliceous sinter; cortex remaining at base. One edge has been steepened and used, probably as a scraper. The source of this volcanic material is probably the Coromandel. A second similar yellowish piece was found in A2, Pit 2, layer 3, and the same material was used for drill points at Koreromaiwaho pa (Fig. 43). A6. Pit 11. Cat.No.10.

Stone file (Fig. 22), a rounded sandstone pebble with surface worn by use and battered at both ends. The material has been identified as a Jurassic sandstone, probably from south of Kawhia or from inland Waikato. The pebble may have been transported naturally to the local beach. A4. East end, in or south of House 2. Cat.No.4.

Stone file (Fig. 23), pointed, made from similar Jurassic sandstone to No.22. Slim pointed files were used in the manufacture of bone fishhooks. For another example from Koreromaiwaho pa, see Fig. 46. A4. West end, south of House 1. Cat.No.3.

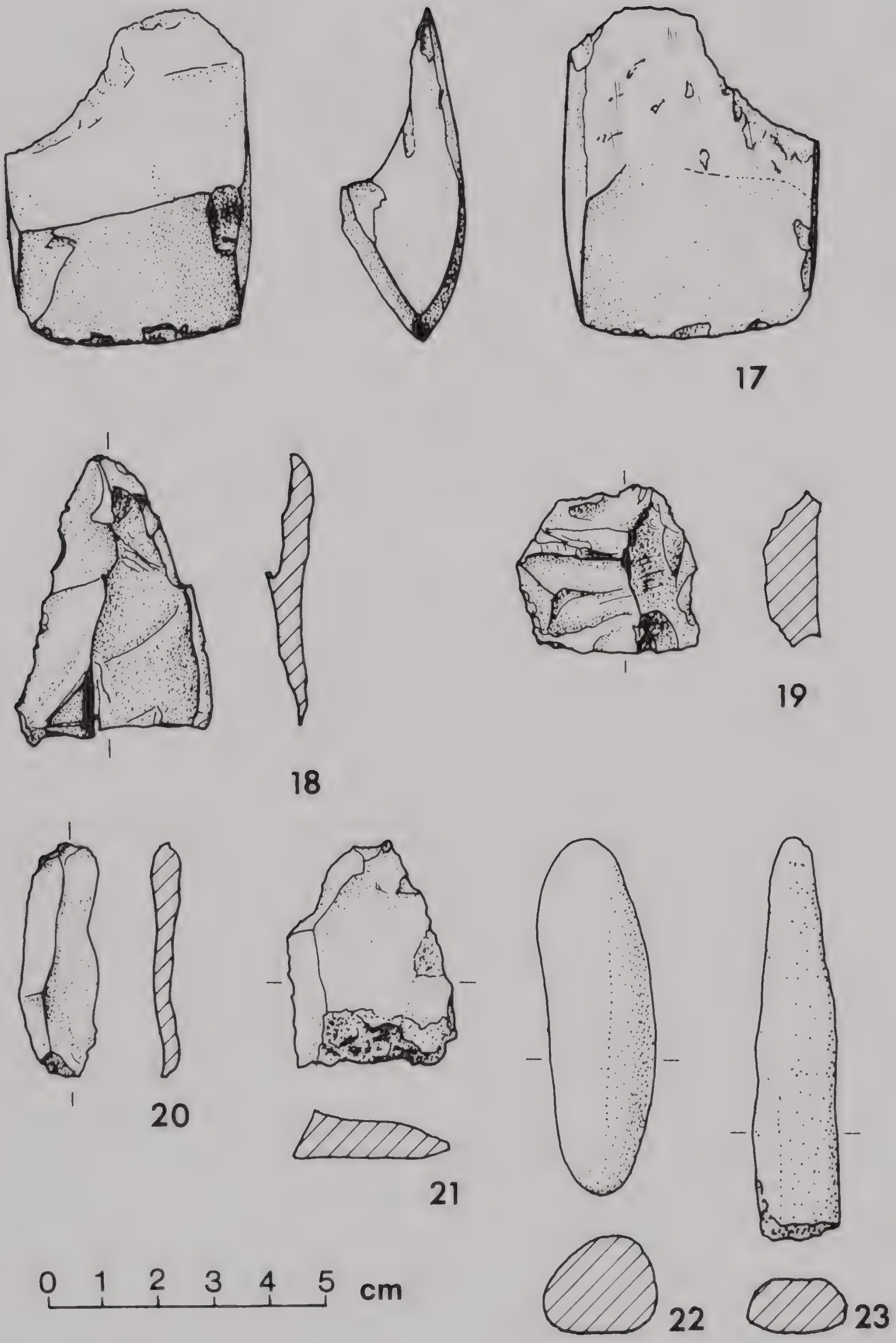
Point of two-piece bone fishhook (Fig. 24), probably made from a bird bone. It has broken at the point of attachment to the shank. Compare Leach, 1979:103, Fig. 17, for the type. A4. Pit 7, filling, layer 2. Cat.No. 17.

Point of a two-piece fishhook (Fig 25), made from a dog's tooth. The tip is missing: the indentations at base are for lashing to the shank. A4. West end of House 1. Cat. No.16.

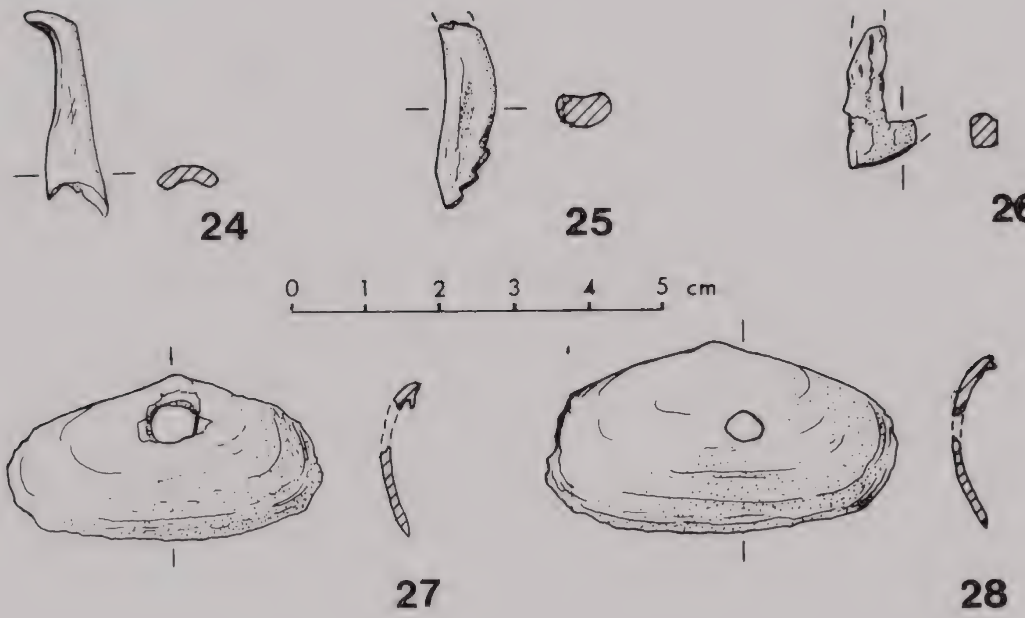
Piece of bone fishhook (Fig. 26), angular and much abraded. A2. Working place, layer 3. Cat. No.19.

Pipi shells (Figs. 27-28), with perforations, possibly artificial, 6 and 4.5 mm in diameter for suspension; the hole of Fig. 27 shows signs of wear. These shells were probably used for ornaments, as earrings or as part of a necklace. A1. In midden around Pit 1. Cat.Nos 42-43.

Pumice (Fig. 29), hollowed out and smoothed to make a shallow cup; probably a container for tattooing pigment. Compare a large example from One Tree Hill summit (Fox 1977:18 and Fig. 16). A4. East end, House 2, layer 1. Cat.No. 25.



Figs. 17-23. Stone artefacts from N64/25.



Figs. 24-28. Bone and shell artefacts from N64/25.

Another larger and better finished example with a lid was found by the former landowner, Mr Kain, on midden exposed on the dunes near North Head. It is illustrated in Fig. 35. It is made from a pale pumice; the lip of the cup and the bottom of the lid have been ground to a flat surface. There is a shallow external groove round both pieces suitable to hold a tie of fibres to attach the lid to the cup.

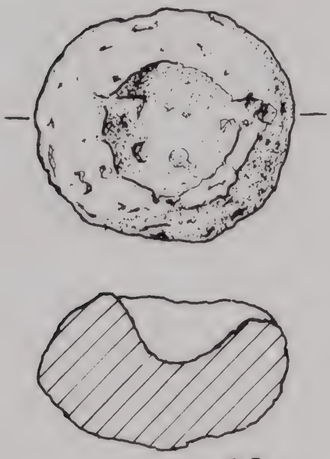
Pumice disc (Fig. 30), slightly hollowed out. A1. South of cook-house. Cat.No. 15.

Rubber (Fig. 31), of local sandstone, flat base, rounded surface, worn by use. Two holes have been drilled at one side, but the wall between them is very thin and has perforated, so the drilling was not finished; probably it was intended to make a sinker. There are two grooves on the opposite side, showing the stone had been used for sharpening points as well as a rubber or polisher. A6. Pit 10 filling, layer 1. Cat.No. 27.

Pumice head (Fig. 32), crudely carved, with back left rough. The large eye sockets are sunk and smoothed, with a thin ridge between them for the nose: the mouth is flawed; the chin and rounded base have been rubbed smooth. A curious piece, probably a trial carving. A2. Pit 2, filling layer 3. Cat.No. 28.

Pumice head (Fig. 33), with incised design on top, which has been ground smooth. Viewed from the side, there is a face with oval protruding eyes below a heavy brow ridge, triangular mouth and jutting chin, all in low relief. It has broken off at the neck. Though the workmanship is crude, this is an effective piece; it is unfortunate that more of it has not survived. A2. Pit 2, filling layer 3. Cat.No. 26.

Cylindrical pumice object (Fig. 34), probably a stopper for a gourd. The surface has been ground smooth and a groove incised around it. A small hole 4 mm in diameter has been started at one side but the drilling was not completed. A2. Pit 2, filling layer 3. Cat.No. 29.



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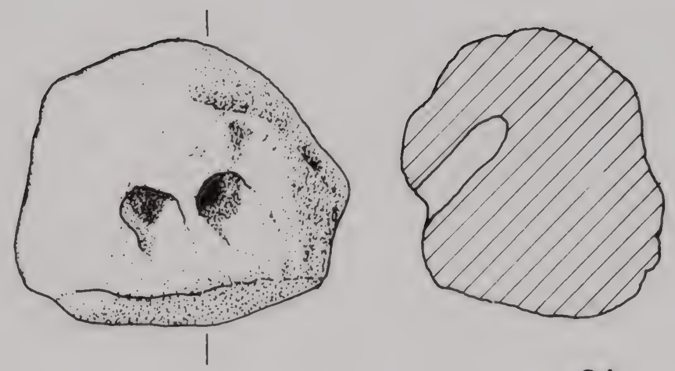

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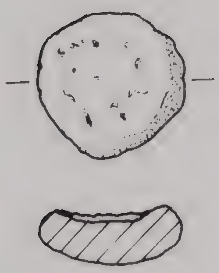

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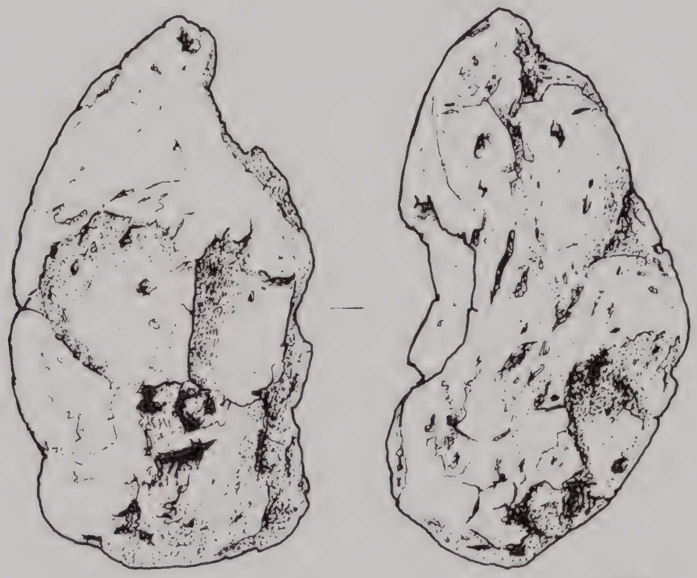

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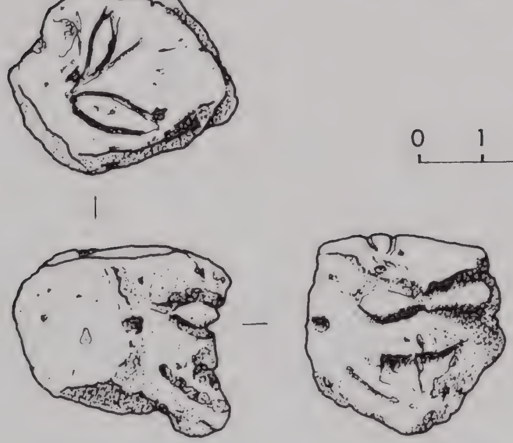

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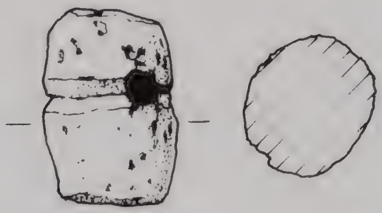

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Figs. 29-34. Pumice artefacts from N64/25.

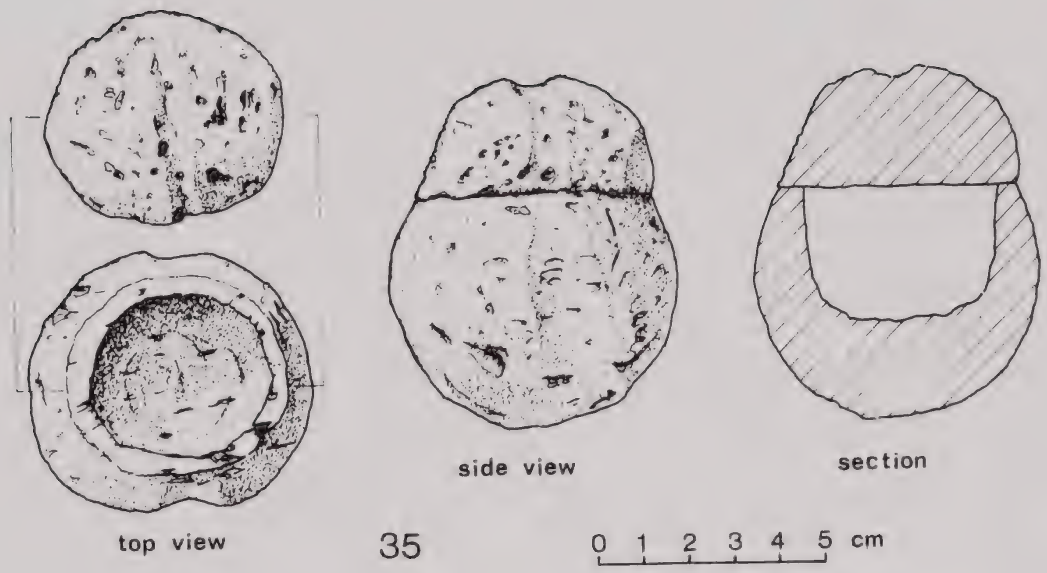

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Fig. 35. Pumice cup and lid from dunes, Aotea North Head.

Stone polisher (Fig. 36), of fine grained cream coloured sandstone obtainable locally. The dish-shaped interior has been worn smooth by heavy use and there are shallow transverse grooves and striations made by sharpening points. The centre has been battered by pounding. A2. Pit 2, filling. Cat.No. 32.

Net sinker (Fig. 37), made from a beach pebble of the local basalt; a shallow groove for a suspension cord has been pecked around it but is incomplete. A4. Working place, layer 1. Cat.No. 30.

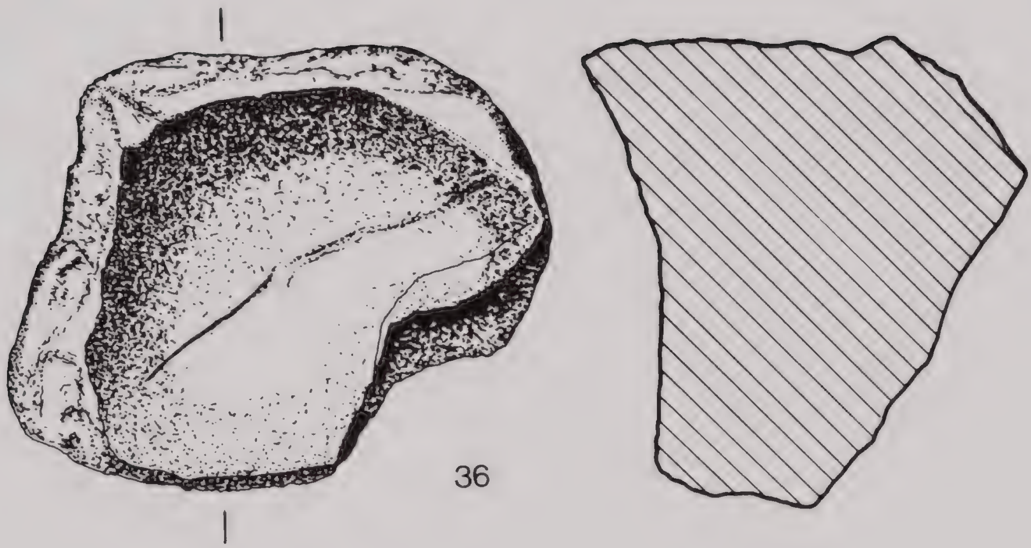
Pumice abrader (Fig. 38), upper surface worn smooth and glossy by polishing. A4. Working place, layer 1. Cat.No. 20.

Greenstone chip. A2, Pit 5, layer 2. Cat.No. 21. Basalt flake 4.5 x 3.5 mm, unused; triangular pointed shape perhaps a trial piece for a drill point. Local material obtainable from near Taranaki Point. A1. Midden around Pit 1. Cat.No. 7.

Pebbles of dark red andesite, obtainable locally on the west side of Aotea Harbour or from Pirongia. These were brought to the site probably for use as pounders or hammers. A4. South of House 1, layer 2. Cat.No. 6; A2. Pit 4, layer 2. Cat.No. 22; A4. Working place, layer 2. Cat.No. 31.

SURFACE FINDS FROM KOREROMAIWAHO PA, N64/8 (Figs. 39-46)

During a visit to study the Aotea sites in September 1982 Fox, in the company of Mr S. Edson of the Waikato Art Museum, Hamilton, visited Koreromaiwaho pa. This small headland pa was on the 61 m (200 ft) crest of the sand dunes *ca.* 100 m south of the Aotea settlement N64/25: successive air photographs recorded its gradual submergence beneath the advancing dunes. It was found that recent westerly gales had swept most of the pa interior clear of sand, exposing the original surface of 3-4 cm thick layer of firm brown loam, with patches of concentrated shell midden and a scatter of artefacts on it. The defences remained sand covered; the ditch was not detectable but the transverse bank had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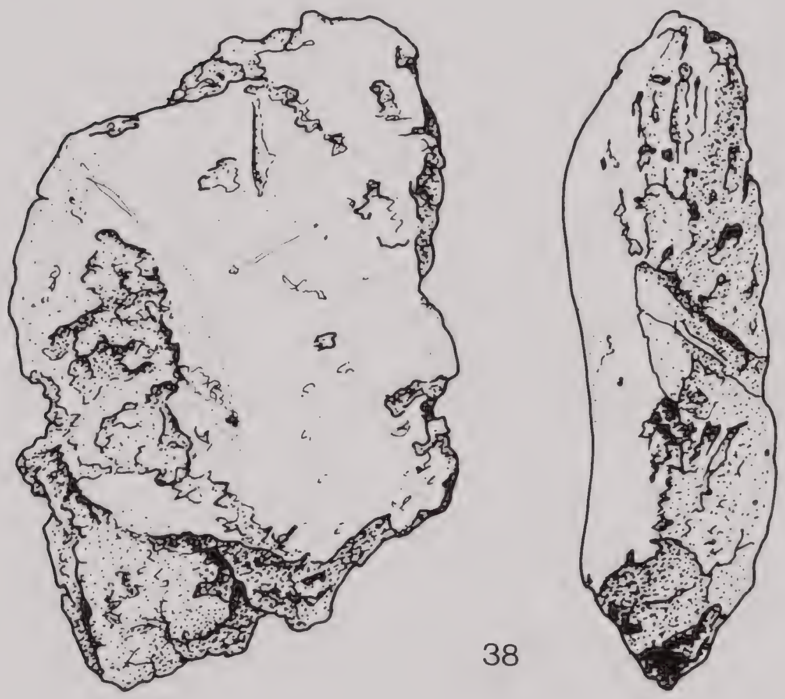
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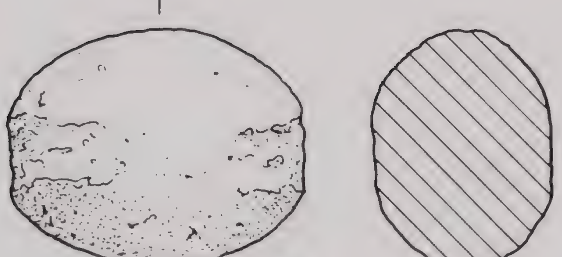
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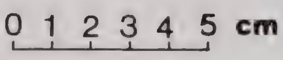
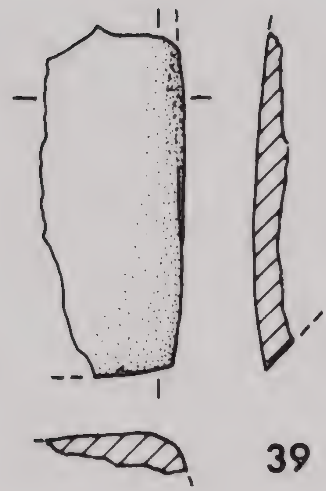


Figs. 36-38. Stone and pumice artefacts from N64/25.



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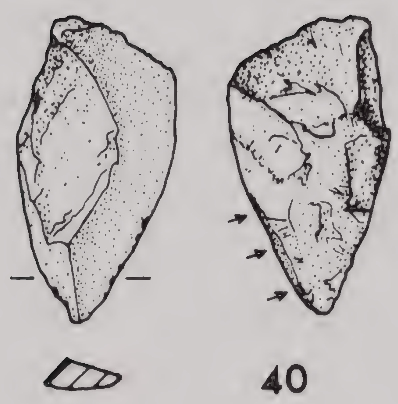

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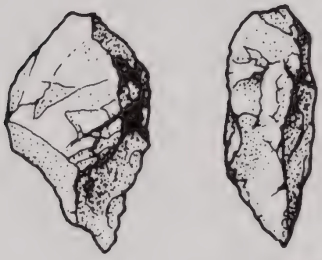

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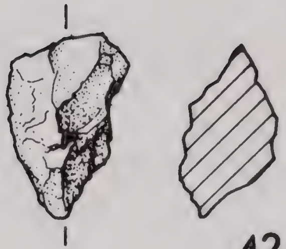

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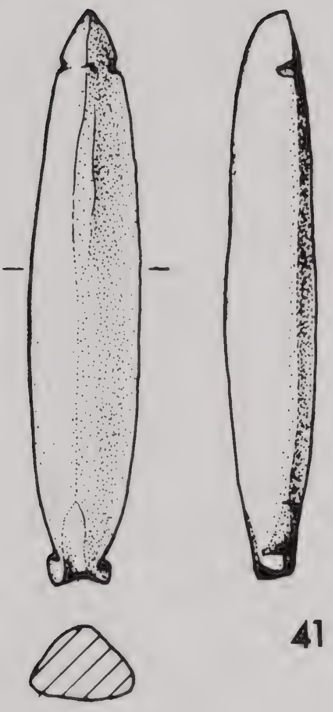

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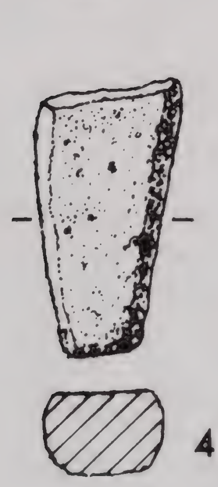

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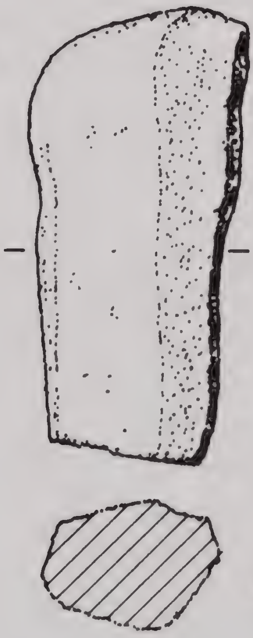

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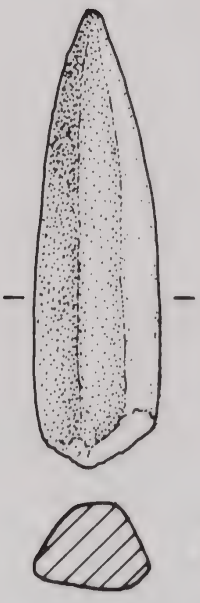

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Figs. 39-46. Artefacts from Koreromaiwaho pa N64/8.

been heightened by blown sand which had lodged against it. There was also a group of rectangular pits which showed up clearly with a pale sand filling surrounded by a rim of brown soil.

The artefacts thus exposed by chance on the interior surface of the pa were found in an area of about 1 x 1.5 m. They were collected officially by Mr S. Edson of the Waikato Art Museum and have been registered in accordance with the provisions of the Antiquities Act. Since they closely resembled others from the excavated open settlement N64/25, they are illustrated in this report as a related contemporary and supplementary group. They are now deposited in the Waikato Art Museum.

Polished adze (Fig. 39), fragment from the blade end. Dr Grant-Mackie identified the stone as a greywacke probably from the Taupiri area of the Waikato. The piece has been used for cutting, shown by the serrated edge.

Polished adze (Fig. 40), thin fragment of blade. Black argillite from D'Urville Island. The piece has been retouched for later use.

Stone trolling lure (Fig. 41), triangular section, minnow type, though lacking eye. It is made from a fine grained sandstone with pale grey surface, from the Kawhia district. At the distal end there is a slight hollow on the upper side to accommodate the bone hook, which was mounted between two lateral knobs and secured by lashings in the notches provided. The head end has similar lateral cuts to secure it to a snood and line.

The type is of early origin and occurs at Wairau Bar (Duff 1977: Fig. 52, No. 188) and at the Washpool site at Palliser Bay (Leach 1979:100, Type A), both datable to the late 12th century. The distribution according to Leach is on both sides of the Cook Strait area, but an extension up the west coast of the North Island to Aotea is now required.

Drill point (Fig. 42), yellow chert of Mesozoic origin, obtainable locally.

Drill point (Fig. 43), of dark reddish brown siliceous sinter of volcanic origin, probably from the Coromandel. Compare Fig. 21 for another example from the N64/25 settlement.

Stone files (Figs. 44-45) of local Tertiary pale grey sandstones: rectangular section showing several faces of use.

Pointed file (Fig. 46), of a dark coarse Jurassic sandstone from the Kawhia area. Compare Fig. 23 for another pointed example from the excavations.

SUMMARY AND DISCUSSION

THE TERRACES AND THEIR FUNCTIONS (A.F.)

The Aotea open settlement is one of the first terraced sites in the North Island that has been systematically excavated. Out of the six to nine groups of terraces that made up the settlement (Fig. 3), four were substantially cleared and it is now possible to discuss their functions and how these were modified during the occupation. This will be done under four headings: housing, storage, cooking and waste disposal, domestic activities and resources.

Housing (Fig. 47)

Two terraces (A4 and A1) had wooden buildings on them, all three built on the firm ground at the back of the terraces. Only one at the west end of A4 fulfilled the usual requirements of a Maori house; this was the smallest of the three (Fig. 47), measuring only 2.25 x 2 m internally, but had a porch 1 m deep. It faced east on to a permanent open space which separated it from a cooking and working place at the opposite end of the terrace (Fig. 10). The house was a curious construction: the ridge pole was supported internally by a row of three uprights, which were decidedly off-centre. In order to have a stable roof of equal weight on either side, the rafters must have extended on the upper side so that their ends rested on the terrace scarp: in effect then, there was no back wall, apart from two subsidiary posts which acted as extra props for the rafters (Fig.47: reconstructed section). Despite its small size, the house was a permanent construction with some of its posts being replaced when decayed. It was probably inhabited by a person of some importance in the small rural settlement.

The second building at the east end of A4 was a late construction with its postholes cutting into the previous cooking place and rubbish pit 7 (Fig. 10). It was a much larger building measuring 4.4 x 2.5 m internally, with a ridge pole slightly off centre. No details of its internal arrangements were obtained and its function is uncertain. It may be suggested that it was a sleeping house for women and others to supplement the small space available in House 1 at the west end of the terrace (A.F.), or it could represent a series of drying racks (R.C.).

The building on terrace A1 was probably an open-fronted cooking shed; it was also a secondary construction with postholes cutting into *hangi* of a previous open-air cooking place (Fig. 4). It seems likely to have been a lean-to construction open to the south, with the sloping roof supported on a horizontal timber carried on substantial uprights at each end, and with wide eaves projecting forwards. One side wall was lightly built, utilising small timbers and stakes, probably interwoven with raupo (Fig. 47). Some *hangi* cooking was carried on inside and midden continued to accumulate. It could have served as a shelter at meal times and the women, children and possibly slaves, may have slept in it as well. A rather similar feature was found at Maioro, South Auckland (Fox and Green 1982:68, House 2, Fig. 11) (A.F.).

Storage

The two largest terraces (A2 and A6) were pit stores (Figs. 8 and 12), and surface indications suggest that the same applies to another terrace at the bottom of the slope west of A2 (Fig. 3). It can be presumed that the majority of pits were for winter storage of kumara from crops grown on the valley floor and its north facing slopes, on soils improved by sand quarried from 'borrow pits' nearby (Fig. 15) as previously described. With the exception of an irregular pit cut in the sandstone (Pit 10, Figs. 12-13), and one possible bin pit (Pit 13, Fig. 14), the pits on these terraces were all rectangular roofed pits, which had a central row of uprights to support the ridge pole. In the two long narrow pits, Pits 2 and 11, some of the timbers had been replaced in new postholes (Figs. 8 and 12) and the small bin Pit 13 had been partly cut away when Pit 11 was dug (Fig. 14). It seems that the pits were intended for long-term use and nearly all on A6 had filled up gradually by the natural processes of erosion, soil slip and hill-wash after they were abandoned (Figs. 13-14). Similarly on terrace A2 there was a natural accumulation of soil to a depth of 40

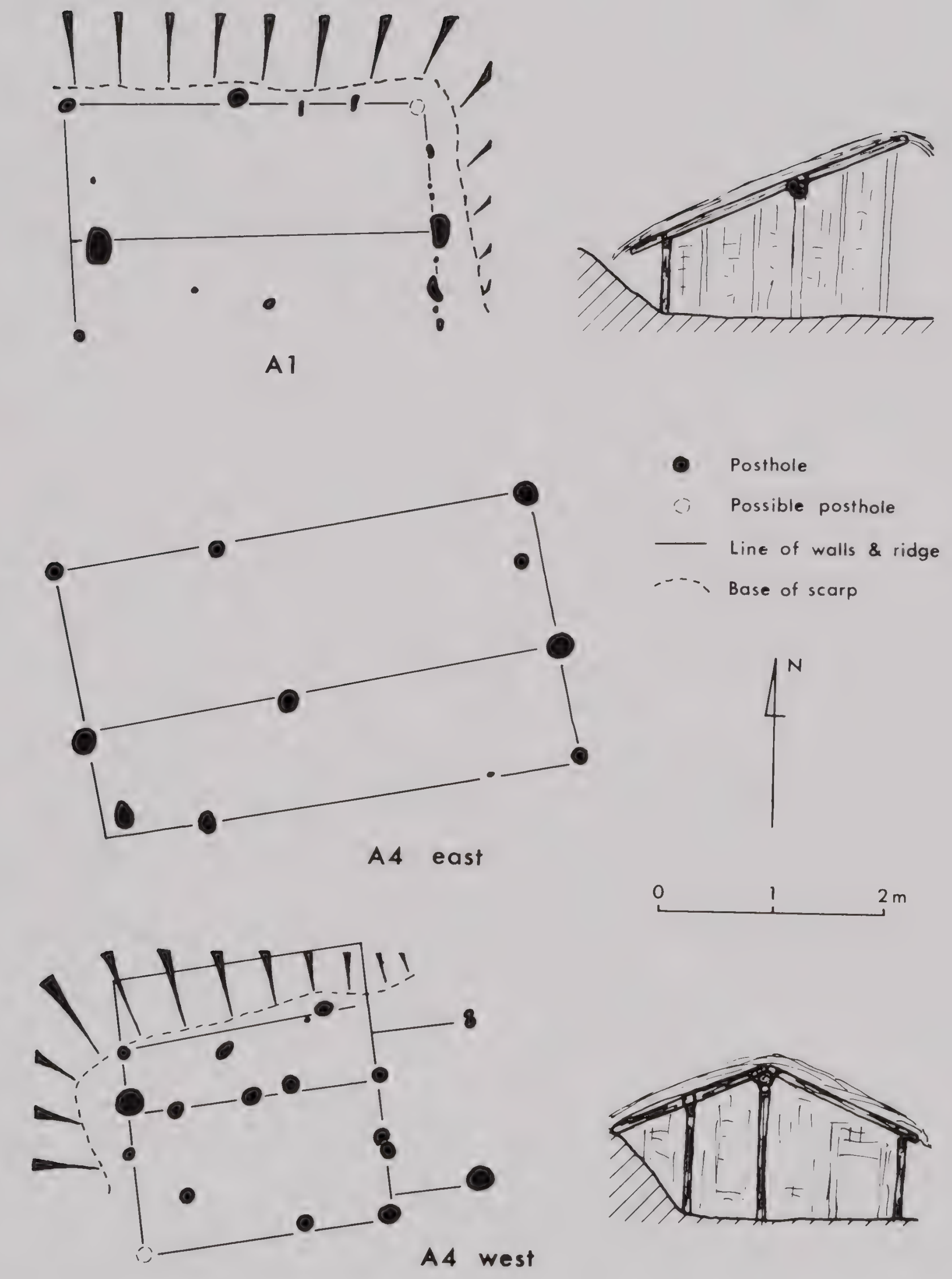

Fig. 47. Reconstruction of timber buildings from the terraces A1 and A4. Drawn by Caroline Phillips.

cm in the pits. There was some secondary occupation in the resulting hollow of Pit 4 where successive hearths and *hangi* had been built for cooking in its shelter (Figs. 7-8), and where some timber slabs where inserted in slots against the pit sides to prevent further slips of loose soil. It can be deduced that the later occupants required less storage space and more room for cooking and food preparation and the disposal of the accompanying rubbish. Pit 5, and two pits on terrace A4 (Pits 7 and 8), were deliberately filled up with *hangi* and midden waste (Figs. 9 and 11) and may have been dug for rubbish pits and not for storage. Two unusual shaped pits with postholes in the angles, Pit 1 on terrace A1 and Pit 6 on terrace A4, may have been used as cool stores, with food suspended in gourds, nets or baskets from an internal timber frame (Figs. 4 and 10).

Cooking and waste disposal

On terraces A1 and A4 a fair amount of space was allocated to cooking. This was done in the usual Polynesian fashion in an earth oven; stones were heated in a shallow circular hollow and the food placed on them wrapped in damp leaves and covered by earth. At the end of the operation, the food would be taken out, the stones removed and the hollow raked out and refurbished for future use. The result was a blackened dish-like hollow which would be deepened a little each time it was used. These are what the excavators found and are shown as '*hangi*' on the plans (Figs. 4 and 10); other similar hollows, marked as 'depressions' showed no obvious burning but may well have been the remains of previous *hangi*.

Originally open-air cooking had taken place in eight or nine *hangi* over the whole of terrace A1, including a succession of three overlying and cutting into each other on the terrace edge. Pit 1 near by was probably used as a cool store at this time. Later an open-fronted shed (Fig. 47) was set up with the timbers of its rear wall bedded in two of the previous *hangi* (Fig. 4). This would have provided shelter for cooking and eating and also sleeping quarters for the women. Examination of the midden around the *hangi* showed that the principal foods were fish and shellfish, mostly pipi and cockles (Appendix 1), with the discarded shells forming the main ingredient of the waste. Much midden accumulated towards the edge of the terrace, burying some of the *hangi* and the filled Pit 1 (Fig. 6), and also spilling down the slope.

On terrace A4 the original cooking place was placed well away from the small House 1, and consisted of a group of at least five *hangi* (Fig. 10). Some of the six similar sized 'depressions' in the middle of the terrace may also have been used for cooking, perhaps at a later date. Much shell midden accumulated and two small pits (Pits 7 and 8) were dug to dispose of it; however, midden continued to be produced, covering both of the filled pits and spilling down the terrace slopes (Fig. 11). Finally, a rectangular building (House 2, Fig. 10) was erected, superseding the earlier open-air cooking place; the mess would then have been confined to the edge of the terrace. In addition, the half-filled disused Pit 4 on terrace A2 was used for *hangi* cooking as previously described; midden was thrown down the terrace slope (Fig. 7).

Domestic activities and resources

The principal occupations of the people in the settlement were kumara cultivation, harvesting and storing, fishing and shellfish gathering and space would be needed for the preparation and conservation of these foods. Kumara would need to be cleaned and sorted before stacking in the pits, and fish likewise gutted in preparation for drying. Many of the shells in the middens showed that the edges had been used for such scraping or cutting of food (Harsant 1983:149). There are places on the terraces clear of buildings and pits where there are small hollows and random groups of postholes suitable for such activities and termed 'working places' on the plans (Figs. 8 and 10). None of the postholes were large or deep enough to support the permanent high wooden storage racks or *whata* similar to those recorded in the deserted Kahouwera pa in the Bay of Islands (Fox 1976:fig.2) but some of the pairs or short rows of small posts could have been for drying, with the fish strung on lines between them. Semi-circles of other posts suggest small temporary shelters were erected.

It is apparent from the finds that some things were manufactured on the terraces. Obsidian was chipped, 43 flakes being recorded, two with cortex: most were found on terrace A4. A few pieces were retouched (Figs. 18-20). Other tools were sandstone files (Figs. 22-23), a scraper of imported sinter (Fig. 21), sandstone polishers (Figs. 31 and 36) and many pieces of pumice abraders, some with glossy polished surface as Fig. 38. Andesite pebbles were used as hammers. Drills had been used to make holes in a sandstone rubber (Fig. 31), and possibly in pipi shells (Figs. 27-28): drill points of chert and sinter were found at the nearby Koreromaiwaho pa (Figs. 42-43). There was no evidence of adze manufacture for which suitable stone was lacking. The pointed file (Fig. 23) and the sharpening grooves for points on the sandstone polishers (Figs. 31 and 36) indicate that the bone fishhooks could have been made on the site. Pumice was used to make a stopper for a gourd (Fig. 34), a cup (Fig. 29), and for crude carvings of a head and face (Figs. 32-33), probably only trial pieces which were discarded.

Most of the raw materials for manufacture were obtained locally; the andesite pebbles and pumice from the ocean beach, the basalt, used for *hangi* stones, from Taranaki Point, and chert and sandstone from the Tertiary formations inland from Manuaitu. Some fine-grained sandstone came from the Jurassic formations near Kawhia. Other substances came from long distances: siliceous sinter of volcanic origin probably was obtained from the Coromandel rather than inland Waikato, according to Dr Grant-Mackie. Analysis of the obsidian by A. Seelenfreund at Otago University showed that half of the pieces (26) originated from Mayor Island; the source of the rest could not be identified. This could be a technical problem or may reflect another source as yet unlocated.

The broken adze (Fig. 17) was made of grey-veined metasomatised argillite from D'Urville Island, as was the fragment of another (Fig. 40) of black argillite from Koreromaiwaho pa; both were probably imported as finished tools.

DATING AND TRADITIONAL HISTORY OF THE SETTLEMENT (R.C.)

The three corrected radiocarbon dates obtained from middens of the second phase on terrace A4 ranged from 440 to 390 B.P. (A.D. 1510-1560 ± 50 years), and another of 420 B.P. (A.D. 1530) obtained from shells in a borrow pit nearby (Figs. 15-16, Pit e), is of the same period (see Appendix 3). There were no signs that the occupation was prolonged, and it probably was limited to the first half of the 16th century and certainly to within the overall time span of A.D. 1460-1610 indicated by the radiocarbon analyses.

According to the traditions, as summarised by Smith (1910) and Kelly (1949), the main events affecting the north side of Aotea Harbour were:

1. The arrival of the Aotea canoe, led by Turi, and the subsequent departure of these people on their southward migration that finally ended at Patea.

2. The settlement of Raglan, Aotea and Kawhia by people from the Tainui canoe perhaps *ca.* A.D. 1350.

3. Whatihua, a chief from Kawhia, settled at Manuaitu, perhaps around A.D. 1500.

4. Several north Aotea settlements were attacked and captured by Karewarewa, perhaps *ca.* A.D 1625 following a series of disputes. The captured settlements include Manuaitu and Koreromaiwaho, the two pa closest to the excavated site.

5. *Circa* A.D. 1700 Kawharu, also from Kawhia, occupied Manuaitu and the other north Aotea sites.

6. Between 1800-1820, a series of battles between various Waikato groups on the one hand, and Ngati Toa and their allies on the other hand (who included Ngati Koata from Aotea) ended in the displacement of the latter. After the departure of Ngati Koata from Aotea the dominant tribes on the northern sides of Aotea Harbour seem to be Ngati Mahanga and Ngati Mahuta of Waikato origin.

The radiocarbon dates from the terraced settlement and a borrow pit, together with the evidence of the artefacts from Koreromaiwaho, suggest that these sites belong to the period following the arrival of Whatihua at Manuaitu, and preceding the defeats of the '1625 A.D.' episode. Although in view of the radiocarbon dates, the later periods are not strictly relevant to this report, it is interesting to note that two of the pa mentioned in the 1800-1820 wars, Ruapuke and Manuaitu, show evidence of lateral ring-ditches being added at a late stage which could plausibly be consigned to this period. Virtually all the sites in the Aotea district named in the traditional histories have been located and the names entered on the N.Z.A.A. site record forms, held at the Waikato Museum.

THE CHARACTER OF THE SETTLEMENT

It is difficult to decide whether the terraces were permanently occupied. There can be no doubt that they would have been inhabited for the autumn harvesting and spring planting season. The question of winter occupation hinges on two alternatives; either the people spent the winter on the terrace sites, where the pits provided most of their winter food, or they lived in the nearby pa Koreromaiwaho, and visited the terraces to collect the stored food when they wanted it. At present the latter alternative seems less likely.

The evidence for mid-summer occupation is not strong: the quantities of shellfish present are very small when the requirements of a family are considered (see App. 1). It seems likely that the shell middens which are so prominent a feature of the sand dunes near the harbour entrance (see Fig. 2, and Cassels 1973) may be the remains of summer fishing and shellfish gathering camps. On balance, therefore, it seems most likely that the terrace settlements were occupied for most of the year except for periods of the summer when the inhabitants were fishing and shellfishing closer to the harbour. The arrangement of a small house fronting on to a permanent open space on terrace A4 (Fig. 10), strengthens the argument against a casual or temporary occupation. It is not possible to tell if all the terraces were occupied simultaneously, but both authors incline to the view that this was the case.

It is envisaged that each family would possess (for a near permanent occupation), a sleeping house, a cooking shed, work areas and storage pits. On this assumption only on terrace A4 were all these elements identified in close proximity: (the three adjoining storage pits (see Fig. 3) although not excavated, are in little doubt). On A1-A2 the sleeping house was not found but all other components were present. On A6 only the pits were found; presumably therefore the missing components (sleeping house, cooking area, etc.) were located nearby on flatter ground.

Finally, the excavations have shed a new light on the differing functions of terraces in undefended contexts; few of these would have been apparent from a surface inspection. In particular the identification of a house on A4 facing east on to a permanent open space and separated from the cooking area signifies unequivocably the presence of a sleeping house, and the senior status of its occupant in this small community.

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APPENDIX 1

N64/25. Economic analysis of terraces Al and A2 (R.C.)

There was about 3.2m³ of midden in the A1 excavation area; of this about .5m³ was taken as samples. Most of the samples were analysed. Shellfish species were identified as follows.

		% by weight
Paphies australis (pipi)	52,448 g	90.36%
Chione stutchburyi (cockle)	4,792 g	8.26%
Paphies subtriangulata (tuatua)	202 g	0.35%
Perna canaliculus (green mussel)	90 g	0.16%
other species	510 g	0.88%

The ‘other species’ category was analysed in detail by Therese Randall, based on one sample. In this sample the following results were obtained (not counting the four most common species listed above). The analysis counted the minimum number of individuals (n = 243).

	Min. no of individuals	*% of total no*
Amphibola crenata	46	18.9%
Cominella adspersa	42	17.3%
Turbo smaragdus	41	16.9%
Elminius modestus	25	10.3%
Epopella plicata	20	8.2%
Maoricolpus roseus	13	5.35%
Diloma subrostrata	12	4.9%
Cominella glandiformis	11	4.5%
Ostrea lutaria	6	2.5%
Xenostrobus pulex	4	1.65%
Mactra ovata	4	1.65%
Lepsiella scobina	3	1.2%
Balanus amphitrite	3	1.2%
Micrelenchus caelatus	2	0.8%
Buccilinum linea	2	0.8%
Venerupis largillierti	1	0.4%
Micrelenchus sanguineus	1	0.4%
Amalda australis	1	0.4%
Zeacumantus subcarinatus	1	0.4%
Diloma bicanaliculata	1	0.4%
Haustrum haustorium	1	0.4%
Umbonium zelandicum	1	0.4%
Oxychilus cellarius	1	0.4%
Phenacohelix ponsonbyi	1	0.4%

Other species were recorded elsewhere in the midden as rare specimens: *Balanus decorus, Chaemisipho columna, Chaemisipho brunnea, Micrelenchus tenebrosus, Zeacumantus lutulentus, Thais orbita.*

By a careful analysis of the stratigraphy within the A1 midden, it was possible to assign ten samples to a chronological sequence. The proportion of the four main species was as follows (% by weight):

	Pipi	*Cockle*	*Tuatua*	*Mussel*
Phase 1 (first phase, bottom layer)	92	7.5	0.02	0.41
2	97	3	—	0.2
3	95	5	0.08	0.14
4	91	8	0.22	0.18
5	94	5	0.94	0.13
6	84	16	—	0.06
7	63	37	—	0.06
8	66	34	—	0.14
9	61	38	0.8	0.18
10 (last phase, top layer)	63	37	0.17	0.11

The shellfish gathering thus shows two main phases. In the first phase, pipi is overwhelmingly the most common species gathered. In the later phase the importance of cockle increases markedly.

The importance of pipi in the site is here expressed in terms of weight of shell. If the analysis had been by minimum numbers, pipi would be about 80% of the total.

A study of barnacles in the midden by Dr Brian Foster of Auckland University, showed that at least one species of barnacle, *Epopella plicata*, must have been gathered deliberately as food, rather than being accidentally incorporated in the midden. He also suggested (pers. comm.) that the presence of remains of *Balanus decorous* indicated winter gathering of shellfish.

A study by Julie Stretton (1974), of breakage patterns of gastropods in the midden, suggested that *Thais orbita*, *Cominella adspersa*, *Cominella glandiformis*, *Turbo smaragdus* and *Amphibola crenata* were intentionally gathered for food and eaten without cooking.

The food value represented by the shellfish on the site was estimated to be about 182,000 calories. If the average person required 1500 calories a day from shellfish, those shells would represent 121 person/days of food. If the site was occupied by a nuclear family of six people, this would last them 20 days.

The following minimum number of animals was identified:

Rats	20	individuals	(mostly *Rattus exulans*)
Birds	4	,,	
Snapper	10	,,	(*Chrysophrys auratus*)
Kahawai	1	,,	(*Arippis trutta*)
Eel	1	,,	(*Anguilla* spp.)
Dogfish	2	,,	
unidentified small fish			
Crabs	4		

The amount of food represented by the midden can be compared to the amount of food that could be stored in the storage pits, using the formula mentioned in Law & Green 1972.

The total storage capacity of all the pits in A1 and A2 was estimated to be 21.86 m^3. If 1 m^3 stores 130 person/days of food, this would last a family of six for 474 days, that is about one and a quarter years.

If we postulate that the site was occupied twice, and new complete pits were dug on the second occasion of the same volume as before, the midden would then represent 10 days of food for a family; and the pits 237 days, or approximately eight months.

The storage capacity of the pits on A6 was estimated as follows:

Pit 14 = 2.184 m^3
Pit 12 = 3.094 m^3
Pit 10 = 2.0 m^3
Pit 11 = 7.56 m^3

14.838 m^3

This compares with the 22 m^3 estimated for the A1 and A2 pits.

APPENDIX 2

N64/25. Midden analysis of terrace A4 (R.C.)

Mollusc species were identified from one set of samples from a baulk where it was possible to place seven samples in chronological sequence.

In this set of samples (Table 1), cockle is overwhelmingly the dominant species, in contrast to the A1 midden. There is no major change in consumption patterns through time. In some other parts of the midden pipi were more common than cockles, but this was not very frequent.

Bones found in the A4 midden include the following: a dog tooth; at least 29 individual rats (of which four are notably larger than the rest, and may be European rats); 17 snapper, 5 parrot fish (*Pseudolabrus* sp.), 1 moki (*Cheilodactylus* spp.) and several dogfish.

Table 1. Shellfish species at Aotea A4 midden.

	Levels							Total	% of Total
	1	2	3	4	5	6	7		
Chione stutchburyi	279	1612	489	547	284	404	153	3768	66.9
Paphies australis	38	227	28	58	50	72	282	755	13.41
Perna canaliculus	5	16	10	115	353	82	26	607	10.78
Paphies subtriangulata	13	42		18	9	27	4	113	2.01
Cominella glandiformis	3	45	26	15	11	6	3	109	1.94
Elminius placatus		2	8		3	10	3	26	
Diloma subrostrata	1	25	7	8	3	1	3	48	
Dosinia anus	4					6	68	78	
Turbo smaragdus	3	4	3	3	8	1	1	23	
Melarhaphe oliveri	2				2	1		5	
Cominella adspersa	1	6	3	4	1	2	2	19	
Thais orbita	2		2	2	1	6	1	14	
Amphibola crenata						6	4	10	
Lepsiella scobina						5		5	
Venerupis largillierti	2		2		2			6	
Zeacumantus lutulentus	2		3		1	4		10	
Ostrea lutaria		8						8	
Xenostrobus pulex					2		1	3	
Cryptoconchus porosus			1					1	
Cellana radians					2			2	
Protothaca crassicosta					1	1		2	
Maoricolpus roseus							3	3	
Xymene ambiguus						3		3	
Micrelenchus dilatatus							2	2	
Maoricrypta monoxlya							1	1	
Evechinus chloroticus			2					2	
Crassostrea glomerata		1						1	
Monodilepas monilefera							1	1	
Chaemisipho columno		1						1	
Melagraphia aethiops				1				1	
Zeacolpus pagoda					1			1	
Haliotus iris						1		1	
Xymene plebeius						1		1	
Mactra ovata						1		1	
Diloma atrovirens					1			1	
Total for levels	355	1989	584	772	735	640	558	5632	

APPENDIX 3

N64/25 and N64/191. C14 dates

Three samples were submitted from the A4 terrace. Although they came from different layers within the site, there is no reason to think they were more than a few years apart in age. Results received from the Radiocarbon Dating Laboratory, Institute of Nuclear Science, N.Z.D.S.I.R., were as follows.

Sample 1. Pipi (*Paphies australis*) shells from A4/E7/lens VI, in the
midden deposit. NZ 1923 A 420 ± 50 B.P.
1923 B 430 ± 50 B.P.

Sample 2. Cockle (*Chione stutchburyi*) shells from A4/F7 layer 2E, in the
midden deposit. NZ 1924 A 380 ± 50 B.P.
1924 B 390 ± 50 B.P.

Sample 3. Charcoal from A4/E6/layers 3B and 3C.
NZ 1925 A 410 ± 60 B.P.
1925 B 420 ± 60 B.P.
1925 C 440 ± 40 B.P.

The charcoal in this sample was identified as twigs of *Hebe salicifolia*, *Carmichaelia* spp., *Coprosma* cf. *cunninghamii*, *Leptospermum* spp. and two fragments of unidentified hardwood species.

The C14 date obtained by Walton (see above) from pipi shells (*Paphies australis*) from fill of a borrow pit (N64/191) gave the following result:

NZ 4523 A 410 ± 40 B.P.
4523 B 420 ± 40 B.P.

This date is obviously virtually identical to the dates from the A4 terrace.

APPENDIX 4

N64/25. Charcoal identifications (R.C.)

Charcoals were identified in samples from A1 and A2 by P.R. Smith (MS.). Charcoal was also identified for C14 dating (see Appendix 3).

Of the 117 samples Smith examined, 23 (19%) were rejected because distortion or wood anomalies prevented accurate identification. The overall result of the identifications was:

Hebe spp.	23%
Litsea calicaris (mangeao)	2.5%
Leptospermum ericoides (kanuka)	16%
L. scoparium (manuka)	3.4%
Lophomyrtus bullata (ramarama)	8%
Pseudopanax arboreum	6%
Melicope (*ternata?*) (wharangi)	2%
Coprosma sp.	7.6%
Dysoxylum spectabile (kohekohe)	3.4%
Olearia (*furfuracea?*)	4%
Beilschmiedia tawa (tawa)	8.5%
Dacrydium cupressinum (rimu)	2.7%

A charcoal sample was obtained from topsoil near the cliff edge above the west coast, a short distance north of the site. The specimens were identified by B.P.J. Molloy as representing approximately equal quantities of *Metrosideros* sp. (probably pohutukawa) and *Pseudopanax* sp. (*arboreum-colensoi* group).

The main result of the charcoal identifications is to show that by the time N64/25 was occupied, the coastal forest had been removed, presumably by burning, and the landscape was dominated by shrubs. Since occasional trees of coastal forest such as pohutukawa, rewarewa, puriri and karaka still survive in the area today, one must assume that they were not used for firewood in the prehistoric period out of choice.

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RADIOCARBON DATES FOR MAIORO, N51/5, SOUTH AUCKLAND, 1965-66

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Abstract. The 1965-66 excavations at the South Auckland site of Maioro were described and interpreted by Aileen Fox and R.C. Green in the previous volume. Their report indicated that six radiocarbon samples had been submitted for age determination, and would be reported when available. The results are now to hand and provide a 13th century A.D. estimation as the age for the initial open settlement occupation of the site, and a 15th century date as the time for its major use as a stockaded *pa*.

When the results of the 1965-66 excavations at the South Auckland site of Maioro (N51/5) were reported, it was indicated that six samples had been submitted for radiocarbon analysis, but at the time of going to press no results had been received from the D.S.I.R. Radiocarbon Laboratory at the Institute of Nuclear Sciences. Thus it was possible to make only a general assessment of the site's chronology (Fox & Green 1982:77). A four phase sequence was postulated. The first was use of the site as an undefended or open settlement, with storage pits, *rua* and terraces. In the second phase the summit portion became a palisaded enclosure with the natural slopes around the knoll being steepened by scarping. Inside the enclosure there were several domestic structures, fireplaces and *hangi*, a new set of roofed storage pits, and new underground *rua*. The third phase was like the second but involved reconditioning and strengthening of the defences, and the building of a new pair of roofed storage pits. In the last phase the defences were abandoned, and a shallow burial was made in the summit area, while on the sides various underground *rua* and storage pits were constructed. A large 6 m square pit on the ridge to the south was also assigned to this phase (Fox & Green 1982:76-77).

Phases 2 and 3 were interpreted as suggesting a relatively short occupation of four or five generations or about 100 years beginning in the sixteenth century A.D. and continuing thereafter (Fox & Green 1982:78). The results of the six radiocarbon determinations when corrected for secular variation so as to provide calendrical ages, indicate that the initial occupation may have been some centuries earlier than expected, and that the main occupation during phases 2 and 3 more likely began in the fifteenth century A.D., and ended in the sixteenth century. They also suggest that the big pit on the ridge belongs to the first rather than the last phase of the occupational sequence.

Context of dates

One sample of wood and charcoal, AU 2056, was taken from the south side of Square E6. It was found in fill at the foot of phase 1 terrace scarp, at the base of the second layer in that square. The second layer in this part of the square derives from a compact white sandstone and yellow loam layer above the terrace scarp which has slipped, washed

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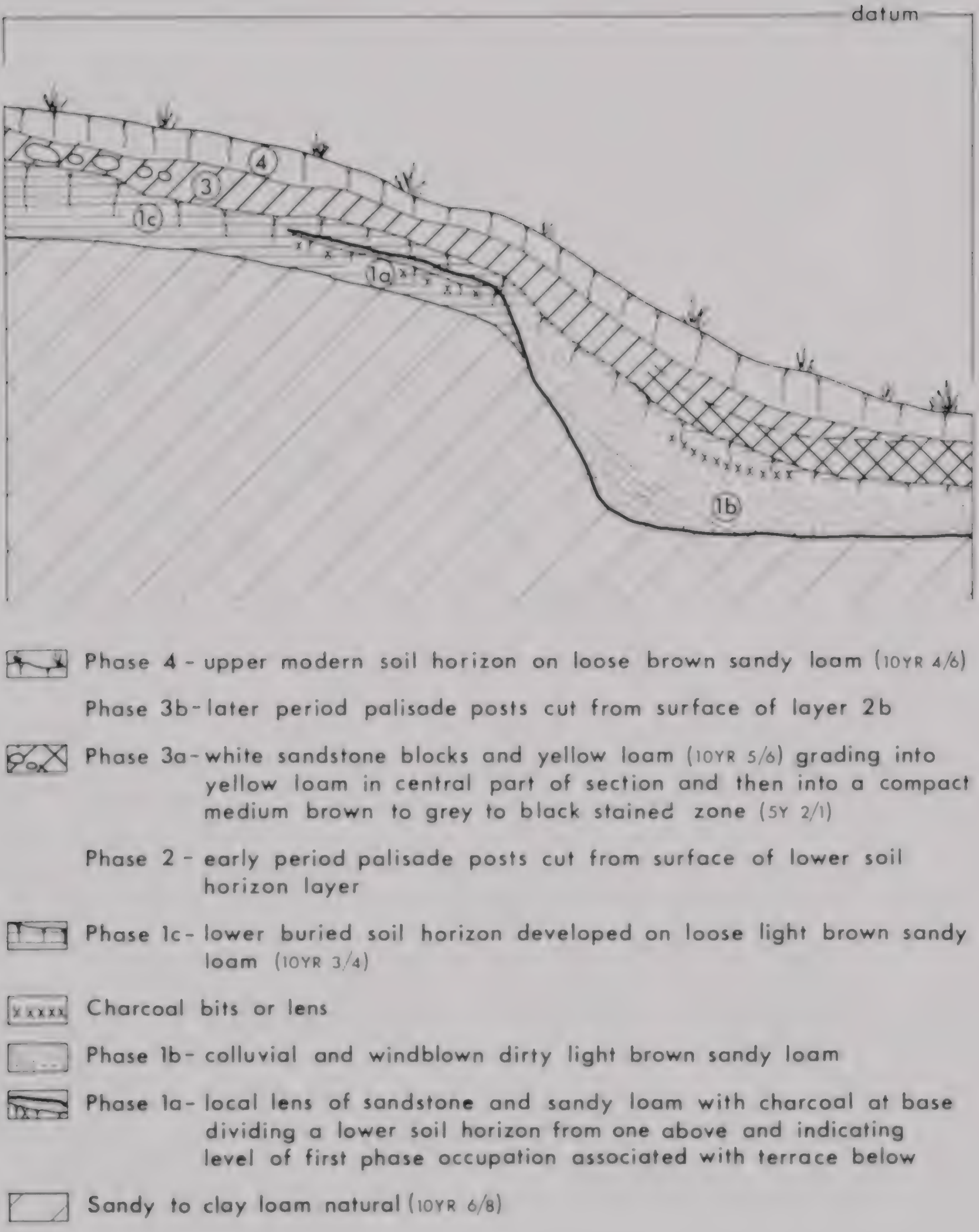
or been thrown down over a dirty light brown sandy loam that had initially accumulated on this side of the knoll, especially along the steep scarp of the phase 1 terrace. The situation is illustrated in Fig. 1. Above the terrace scarp the surface of the phase 3 second layer is firmly associated with the later alignment of palisade postholes on this side (Fox & Green 1982:62). The earlier line of palisade postholes derived from the phase 2 surface of the soil horizon immediately under it. Indications of a still earlier occupation surface, associated with phase 1 and the terrace, were also noted on this side in this section only.

On the downhill side of this square charcoal lenses and patches frequently occurred either near the surface of the phase 1 fill (as in the illustrated section) or at the base of the overlying second layer. Presumably they derive either from charcoal associated with the phase 1 activities, which had been eroded from higher up and deposited here, *or* they derive from occupation debris that accumulated beyond the earlier phase 2 palisading, which at that time occupied this surface along this side of the knoll. For this reason, the derivation of this sample is ambiguous with the basal second layer context, suggesting it is slightly more likely that it derives from phase 2 than from phase 1. However, the radiocarbon age of the sample (NZ 6278) of 873 ± 55 years B.P. clearly implies that phase 1 is a more reasonable interpretation when compared with the remaining radiocarbon results (see below). Therefore an alternative is to consider that while its position derives from phase 2 activity, the result has an inbuilt age, a situation commonly encountered in New Zealand (McFadgen 1982:384). Thus the result may well represent a use of old wood and charcoal of phase 1 during the phase 2 occupation on the knoll, or it may also represent use of contemporary wood and charcoal deposited there during phase 1 in a context undisturbed by phase 2 activities. The sample was, in either case, scooped up with the second layer fill during the refurbishing of the inner knoll surface when the palisade of phase 3 was constructed and the earthen material from the interior distributed to the perimeter of the palisaded enclosure and down the side of the knoll. The conclusion I reach, is that the result is a useful estimate for the age of the phase 1 occupation, however one interprets it.

A sample (AU 2003) catalogued as "posthole material (not a charcoal sample) from the Square F7 part of *baulk F-G7*" was collected on 1 January 1966. The collection date was when the pit and deep posthole of the baulk feature, interpreted as a rack or *whata* support (Fox & Green 1982:68), were both excavated and drawn up. This was after the features and sections of Square F7 itself, and especially of long pit 8, had been completed on 30 December 1965. Thus this sample does not come from long pit 8 of Square F7 as originally believed by Fox & Green (1982:65). The fill of the squarish post pit above the deep posthole of the *whata* feature is not indicated on the published section drawing (Fox & Green 1982: Fig. 8 Y^2-Y^1) but on the original section drawing notes it is stated to be "a very fine light brown sandy fill with some lumps of sandstone (packing around the post?) which was probably cut and filled in the earlier period . . .". The notion that Green had then that the posthole was later, on analogy with nearby Rua 6, is inappropriate and of course stratigraphically impossible. Rather both the squarish post pit with deep posthole and the adjacent slanting post pit in G7 (Fox & Green 1982: Fig.8), with the same fill, are clearly recorded on the original sections and plans as early features. Therefore the *whata* post on stratigraphic evidence should not be assigned to the phase 2 reconstruction of the palisaded enclosure on the summit (Fox & Green 1982: Fig.11), but interpreted as a feature of the open settlement of phase 1. Incidentally the slanted post adjacent to and contemporary with it, now makes sense as probably being for the notched log ladder used



Phase 4 - upper modern soil horizon on loose brown sandy loam (10YR 4/6)

Phase 3b - later period palisade posts cut from surface of layer 2b

Phase 3a - white sandstone blocks and yellow loam (10YR 5/6) grading into yellow loam in central part of section and then into a compact medium brown to grey to black stained zone (5Y 2/1)

Phase 2 - early period palisade posts cut from surface of lower soil horizon layer

Phase 1c - lower buried soil horizon developed on loose light brown sandy loam (10YR 3/4)

Charcoal bits or lens

Phase 1b - colluvial and windblown dirty light brown sandy loam

Phase 1a - local lens of sandstone and sandy loam with charcoal at base dividing a lower soil horizon from one above and indicating level of first phase occupation associated with terrace below

Sandy to clay loam natural (10YR 6/8)

Fig. 1. Detailed cross-section for north-eastern wall of Square E6, Site N51/5, Maioro (see Fox & Green 1982: Fig.6 for location of section).

to gain access to the small structure or rack built at the top of the post support. They are associated with a fine polished argillite adze (Fox & Green 1982:68, 72 & Fig. 17).

The radiocarbon age of the sample (NZ 6275) of 821±47 B.P. fully supports the phase 1 interpretation for its context. The deep posthole was some 180 mm (7.2 inches) in diameter so it is doubtful that the post it contained had more than 20 to 40 rings or that they came from a tree more than 60-80 years old. For this reason the sample is regarded as giving, when taken towards the younger end of its age range, a reasonably good indication of time for the phase 1 occupation.

Sample AU 2082 was of small *pipi (Paphies australe)* shell recovered from a ¼ inch sieve in the southeast quadrant of the Square F10-11, excavated to define the very large Pit 10 located on the ridge to the south outside the summit defences (Fox & Green 1982:69). The shells derive from a period when Pit 10 had been abandoned and was used as a dump. Fox & Green (1982:77) argued that the existence of a large roof covering a 6 m square pit would have blocked the view along the ridge, rendering the defences of phase 2 and 3 ineffectual. This suggested Pit 10 belonged either to the first or last phase. Because Fox and Green had no stratigraphic evidence for its position in their chronology, they opted for a final phase date for it. However, the radiocarbon age of this sample (NZ 6279) of 492±35 B.P. indicates they made the wrong choice, although the reasoning was correct. As comparable dates for phases 2 and 3 described below will show, the deposition of the shells and use of this pit as a trash dump belongs to phases 2 and 3. Big Pit 10 should be assigned instead to phase 1. This makes it contemporary with a similarly large pit, 9, adjacent to it, which stratigraphically did predate the palisading of phases 2 and 3 (Fox & Green 1982:70).

The location of AU 2051 is fairly well recorded in the notes and the drawing for Square F5. It came from a 61 cm^2 patch just inside the phase 3 palisade posthole alignment across the square on the edge of the knoll, and sealed in by the second layer, the deposition of which was associated with the reconstruction of the phase 3 palisade. The sample then is securely associated stratigraphically with the phase 2 palisade postholes on this side (Fox & Green 1982:64), and as the notes say "from the stratigraphic sequence and the amount of wood, much of it partially charred and *totara* from its look, the post butts were burned off at this level to the ground, and then the area renewed by a buildup of clay". The radiocarbon age of the charcoal sample (NZ 6277) of 420±52 B.P. therefore gives a very good estimation for the period when the open settlement was converted into palisaded summit enclosure.

The exact position of AU 2002 is also well recorded. It is also from phase 2, this time from a deep palisade posthole in the baulk F8-9, in the portion of the square assigned to F9 (Fox & Green 1982:62 and Fig. 6, Fig. 8 Y^2-Y^1). The radiocarbon age of this charcoal sample (NZ 6274) of 345±51 gives an age estimate for phase 2 that can be directly compared with the previous sample.

The position of AU 2035 is not quite so precisely fixed as the previous two. It is recorded as coming from the fill of a posthole in the southwest corner of Square F5, and the original feature plan of this square reveals three postholes in that corner region, two of phase 3 and one of phase 2. The posthole nearest the southwest corner belongs to phase 3 and is the most likely candidate (Fox & Green 1982: Fig. 6). While not significantly different statistically from the previous two dates, it does yield a slightly younger age range as would be expected. The sample (NZ 6276) has a result of 293±56 years B.P.

Calendrical age of occupation

It is now well known that radiocarbon results have to be calibrated for secular effect to obtain accurate calendrical dates. The D.S.I.R. Institute of Nuclear Sciences' Radiocarbon Laboratory has long done this on the basis of a secular correction as distributed in 1972 at the 8th International Conference on Radiocarbon Dating by H.N. Michael and E.K. Ralph (an up-date of that published, Michael & Ralph 1972), and appropriately calibrated ages are routinely supplied for each radiocarbon determination in their summary reports. As a matter of policy the laboratory does not attempt secular corrections for shell or other samples of marine origin, because of the solely terrestrial (tree ring) origin of the present calibration curves. The results supplied by the New Zealand laboratory are given in the first column of Table 1. I have followed McFadgen's (1982) suggested procedure for calculating an uncalibrated but comparable age for the shell sample.

Table 1. Calendrical age corrections for six samples from the Maioro site (N51/5).

Source:		Michael & Ralph (1972)[1]	Stuiver (1982)	Klein et al. (1982)
Confidence Limits:		67%	67%	95%
Laboratory No.	*Phase*	A.D.	A.D.	A.D.
NZ 6276	3	1510-1630	1435-1665	1580-1700
NZ 6274	2	1470-1570	1420-1650	1440-1570
NZ 6277	2	1440-1540	1400-1525	1390-1500
NZ 6279(shell)	2-3	- - - - -[2]	1340-1485	1390-1470
		1400-1600[3]		
NZ 6275	1	1100-1200	1060-1275	1160-1280
NZ 6278	1	1040-1160	1035-1255	1100-2220

[1] This is a secular correction as distributed at the 8th. International Conference on Radiocarbon Dating by H.N. Michael and E.K. Ralph, but is different from and up-dates that published in the volume from that conference. It is the one currently employed by the New Zealand laboratory in supplying corrections for secular effect to samples of terrestrial origin.

[2] The New Zealand laboratory does not correct shell samples for secular effect.

[3] McFadgen (1982) supplies the best approximation that can be used in the last 1000 years in New Zealand to get an equivalent calendrical date to those on charcoal and wood. This represents a 95% confidence limit.

The Michael and Ralph table for secular correction is only one of a great number of calibration curves that have appeared (Klein *et al.* 1982:103-104). These have all been used by archaeologists, with little consensus as to which are the more appropriate. All reflect similar long-term changes in atmospheric radiocarbon concentrations, yet differ significantly in their treatments of shorter period variations (Klein *et al.* 1982:104). Also a much larger number of dendrochronologically dated wood samples have now been analysed by much more precise radiocarbon techniques, and the sources of the wood samples have been extended regionally from chronologies for bristlecone pine to those for giant sequoia, douglas fir, Irish oak, and German oak.

Now two new calibration curves have appeared which overcome some of the problems involved. One is a high-precision calibration curve from the Seattle laboratory (Stuiver 1982) which has been shown to have near universal acceptability in that it exhibits only negligible differences in atmospheric C14 levels with other regions, and minor but calculable differences due to laboratory bias or calibration methods. The possibility of systematic radiocarbon age differences from the northern hemisphere curve for the southern hemispheric samples still has to be tested in more detail, but an upper limit for them appears to be 32 to 40 years (Stuiver 1982:5, Polach 1976:275-76). The other calibration is a consensus data table based on 1154 samples from five laboratories and two species of wood (Klein *et al.* 1982). An advantage of this calibration table is that it provides *date ranges* at the more useful 95% confidence limits, the range being chosen according to the size of original laboratory error. It also provides a means of determining results when more than one date range is possible for a single radiocarbon result.

Calendrical age range for the six Maioro site samples based on these two calibration curves are supplied in the second and third columns of Table 1. The intent is to assess and perhaps improve on the calendrical age ranges supplied by the New Zealand laboratory. I have applied these calibration curves to the shell sample also simply to see if they indicate any difference with results obtained by using the method recommended by McFadgen (1982:384).

From the discussion of context in the previous sections and from Table 1, it is evident that fairly accurate calendrical assessments for phase 1 and for phases 2 and 3 are indicated by the age ranges. Samples NZ 6275 and NZ 6278 have been related above to phase 1 events at a time when the site was an open settlement. The dates are not significantly different from each other statistically, and support the notion that if one sensibly chooses the upper limits of their age range then occupation of the site had begun by the thirteenth century A.D. This is a very interesting outcome in light of the association of phase 1 with the 2B imported argillite adzes. Once again we have evidence of an undefended settlement with large storage pits during what is generally thought to be the archaic period. In this respect it may be compared with the early Skipper's Ridge open settlement (N40/7) (Davidson 1975:75). Our image of what are proper archaic sites is still too dominated by artefact and bird bone rich beach middens, at least in the North Island of New Zealand, to easily pick out other sites as also of possible early age.

Samples NZ 6274 and NZ 6277 provide an excellent means for estimating the calendrical age of phase 2 when the site first functioned as a stockaded *pa* enclosure. A palisade post and charcoal patch, both with nearly identical results, attest to a fifteenth century A.D. occupation.

This is at least a century earlier than was anticipated (Fox & Green 1982:78). A supporting radiocarbon result not statistically significantly different from these two is NZ 6276. It is for a posthole fill, probably of phase 3, although phase 2 is not impossible. On the phase 3 interpretation preferred here, it would support our previous assessment that the phase 2 to 3 interval represents "a relatively short period of occupation, say 100 years or four or five generations of a chiefly family" (Fox & Green 1982:78). On the three calibrations of its age range, and especially the Klein *et al.* it could be argued that a sixteenth century A.D. age for phase 3 is more likely. It was during the phase 2 to 3 occupation, on the evidence of an identical age for NZ 6279, that the use of large Pit 10 as a trash dump also occurred, which places the use of Pit 10 as a storage structure in phase 1.

The implied time interval of no occupation during the fourteenth century A.D. between the phase 1 occupation and that of phases 2 and 3, is indicated in places on the site by a soil horizon as in Fig. 1. Such an interval would be required for a horizon of this type to form. Phase 4 when the site again was used as an open settlement or storage and burial area apparently followed shortly after phase 3. Although undated by radiocarbon samples a sixteenth to seventeenth century A.D. date is most likely. Thereafter the open pits record the last three centuries in the upper layers of their highly stratified fills as in Pits 3, 5 and 8 (Fox & Green 1982:68-69 and Fig. 8).

Conclusion

The Maioro site, when it was excavated, was thought probably to be a late site which would help to resolve the distinction between the then newly defined archaeological category of undefended settlement and that of the defended site or *pa*. The answer to that question has proved to be that at different points in its history it was both. It is also now demonstrated that the original assessment of the chronological age of this site, and even that in 1982, was mistaken. Successive occupations there have proved to be much earlier than expected. The site began as an undefended settlement in the thirteenth century, became a twice palisaded *pa* in the fifteenth and sixteenth century A.D., and open settlement again shortly thereafter. Features associated with the first phase provide more evidence of the existence of large and small store pits from early in New Zealand prehistory and establishes for the first time a respectable antiquity for some form of raised storage platform as predicted by Geelen de Kabath (n.d.:14). Subsequent occupations provide a solid antiquity, 1400-1650 A.D., for the palisade defended *pa* with only minimal terrace scarping, and no major earthworks like ditches or banks. Finally during this period the site displays something of the internal arrangements within a summit enclosure.

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A PLACE OF RITUAL ON THE WESTERN SHORES OF LAKE TAUPO

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Abstract. A place of ritual, burial mound and "*Uenuku*" marker posts are reported from the western shore of Lake Taupo.

On a Maori land block on the west shore of Lake Taupo there is a natural amphitheatre in the hills. It consists of a plateau bounded in a semicircle by low hillocks with a moderate slope leading down on the open side. The natural access way is by a stream bed on the south side leading to a break in the hillocks allowing access to the rear of the amphitheatre. The area enclosed is approximately two hectares. The semicircle is open to the east and is well positioned for the rising sun to shine directly into the central area.

The place was brought to notice by the Maori Trustees of the block who planned to remove the low scrub and replace it with pasture. A pair of posts on a low mound to one side of the centre were discovered and reported to the Department of Maori Affairs and Auckland Institute and Museum. More recently the New Zealand Historic Places Trust has been consulted.

These posts resemble the post figure "*Uenuku tuwhatu*" in the Te Awamutu Museum (Fig.1). This latter post symbolises the tribal god of the Waikato tribes. It is a *taumata atua* or resting place of the god who is said to have brought the Tainui canoe to Kawhia.

I visited the area on the west shore of Lake Taupo and found that the two posts stood on a mound about three metres long by two metres wide and *ca.* 40 cm high (Fig.2). The mound itself is somewhat pear-shaped and the posts stand near the wider end. One post has lost its front portion but is still upright (Figs.3-5), the other has lost the back portion and lies on the ground (Fig.6). Both posts are badly weathered and covered in lichen and at some stage have been damaged by fire. It is difficult to judge their original size as the portion of the post still standing is just over 1 m high. The robustness of the curving top would suggest that the original post stood about 2 m above the mound with about a half metre, or about the height of the mound, below soil level. Uenuku in Te Awamutu Museum stands 2.67 m high. There are no obvious signs of metal tool working although the weathered state precludes certainty on this point.

Photographs of the posts (Figs.2-6) were shown to knowledgeable *kaumatua* who were able, not only to identify their purpose but also, to name the area in which they stood. The elders consulted were Hemi Te Riria, Te Hape Tamihana, Emere Hape Te Rauna and Materoa Ngarimu Tamihana who belong to the *ariki* (paramount) lines of Tuwharetoa, Tuhoe, Ngati Kahungunu and Ngati Porou.

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Fig. 1. "Uenuku tuwhatu" the god symbol in Te Awamutu Museum. No. 2025. Height 267 cm.

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Fig. 2. The standing burial post and mound viewed from the east. Note the shallow quarry trench in the foreground which delineated the mound.

The amphitheatre is named as *Te Tupapara o Te Koroiti ko Tama* and is a ceremonial centre of very great antiquity dedicated to the *Koroiti Ko Tama*, the ultimate life force (Binney 1968:172; 1982). *Te Tupapara o Te Koroiti Ko Tama* is a natural area which was not marked by any structure, a not unusual occurrence (Best 1924:170). Some centres association with the *tohi* rites for a *tohunga* of the Koroiti are marked with three unworked stones. There was such a centre near Punuruku in Northland. The stones have been removed now and are placed at the gate of the Punuruku primary school. In the *tupapara* at Taupo the stones were not located in the scrub but should have been in a triangle with the apex to the rising sun at the centre of the area opposite the open side. The mound on which the posts are situated is sited to the right hand side; it is thus to the south of where the stones should be, remembering that the amphitheatre opens to the east.

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Figs. 3-6. 3. The standing post viewed from the side. 4. The top of the standing post. 5. The standing post viewed from the front with the top of the second post lying at the base. 6. The top of the fallen post lying against the base of the standing post.

The posts are burial markers recording the resting place of Tutanekai Taniwha, the son of Tuwharetoa. Tutanekai was a *poriro* or bastard as his mother was Rangiuru, wife of Whakauekaipapa, ancestor of the Arawa tribe of Ngati Whakaue (Grace 1959:107). Tuwharetoa was an important and powerful *ariki* and Rangiuru belonged to an important family line. These factors, combined with his prowess as a leader, led to his recognition as an *ariki* despite the circumstances of his birth. The interment of Tutanekai in *Te Tupapara o Te Koroiti Ko Tama* is a recognition of this position. The posts mark the *taniwha* line of *ariki* descent, the *teina* line superseded only by the *tuakana* line itself. The placing of Tutanekai and the erection of the mound and markers was made some time after his death and was a secondary interment. Tutanekai himself lived some twelve to thirteen generations ago. The post markers have probably been replaced during that time. The present set seem to be pre-European and are stated by the elders to have been put up "long before the *Pakeha* came"

Some five generations after Tutanekai's burial, Makaturangi, a female descendant of Tutanekai, was placed in the same mound. Makaturangi was an ancestress of Pirihita Pateriki of Tuhoe. A further burial in the mound was Tuwaikapu, either at this time or a little later. These latter burials are probably in the portion of the mound which does not contain the posts, the narrow end. It is unlikely that even an *ariki tohunga* would wish to disturb the remains of Tutanekai.

The conservator of the Auckland Museum has recently cleaned and restored the gateway of Pukeroa pa, Ohinemutu (Fig.7). According to museum records, this is the gateway that looked out Mokoia Island, the meeting place of Hinemoa and Tutanekai. The figure depicted is identified as Tutanekai.

Two further "Uenuku" posts are known to have existed. They are named as *Makatororangi* and *Te Arikinuipoihi*. These posts stood in Ngati Kahungunu and Ngati Maniopoto territory respectively in Hawke's Bay and the King Country.

Discussion

The place of ritual for the *Koroiti Ko Tama* on the west shore of Lake Taupo is similar to the centre mentioned for the Ngati Wai tribal area at Punuruku. There were similarly orientated natural places marked by three stones in other tribal areas. Unfortunately once the stones are removed only local tradition can identify the exact place. During the last century, stones and other associated markers were often buried so that no physical trace now remains. In the *ariki* ritual places, burials of importance on the male descent line were put to the right-hand side (south), lesser burials derived from a female line were placed to the left, i.e. north. Burials in such places are rare and were only made as a mark of special distinction. Ultimately such favours reflected political attitudes of the time.

The use of "*Uenuku*" type posts to mark the burial of Tutanekai is an acknowledgement of his status and of the importance of descent through the *tuakana* lines of Tainui. The number of "spikes" on the top and their design is a device to convey genealogical information, while the form identifies descent on the "*Taniwha*" lines of Tainui. It is the information conveyed by the posts that enabled certain identification of the burial to be made by the *kaumatua* and once this was accomplished, naming the place was a fairly simple matter.

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Fig. 7. The Pukeroa gateway depicting Tutanekai, photographed at Ohinemutu *c*. 1860, when it had been re-erected and the opening enlarged. (Note tattoo on the right cheek. The penis has been removed.) AM 160. Height, 380 cm overall.

Photo: Burton Bros.

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WHAKAPAKOKO RAKAU

Godsticks

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Abstract. A godstick from Ngataringa Bay in Auckland recently acquired by Auckland Museum is compared with known examples. The named set in Cambridge University Museum of Archaeology and Ethnology, the examples in Wanganui Museum recorded by Barrow, the set in Auckland Institute and Museum and other named examples are examined for information on the function of such sets.

It is now possible to examine the context and associations of the known sets and to determine their functions within the wider setting of the complete corpus of Maori godsticks.

Recently Auckland Museum acquired a godstick or *whakapakoko rakau* (Figs. 1,2), which had been found many years before at Ngataringa Bay, Devonport. This stick depicts a head with sloping ridged forehead and very stylised face surmounting small shoulders and hands. It is large, 44 cm long by 7-8 cm wide, made of puriri wood (*Vitex lucens*) (A.E. Wright pers. comm.) with the shaft tunnelled by sea borer (A.B. Stephenson pers. comm.). Ngataringa Bay is a mudflat area and sea borer is endemic to the area. Godsticks of this form have not been known previously for the Auckland area.

The Ngataringa Bay godstick is identical in form with that named as Hukere (Skinner 1922:168), in the set originally belonging to the Rev. Richard Taylor, in the ridged forehead, open mouth, plain shoulders and arms with hands on chest.

In 1923 George Graham (1923:50) noted four *aria* or god representatives belonging to Ngati Whakaue of Mokoia Island, Rotorua. One of them named Itupaoa "consisted of a figurette woven in human hair, roughly in the form of a head and tapering downwards to a point. The hair was plaited on a wooden rod as base — such is the rather indefinite description that has been handed down. The other three figures, whose names I do not now remember, were taken away by Nga Puhi. I do not think they were ever returned as were other tribal heirlooms in after years." The other gods represented were probably Maru and Rongomai (White 1856:26) or Kahukura and Rongomai (Grey 1928:71) or Maru, Rongomai and Ihungaru (Cowan 1910:110). Graham also mentioned (1923:50) that he saw "a much decayed specimen found in a cave at Mangere (near Auckland) which was taken to England by Kerry-Nicholls".

In 1959 and 1961 Barrow (1959, 1961) listed all the known sticks which he localised to the Wanganui/Taranaki regions. At the same time, Archey (1960) was of the opinion that godsticks were more widespread and moreover, have parallels in Polynesia (ibid:303). Barrow, in his second paper (1961:228) agreed with the latter point.

Rec. Auckland Inst. Mus. 20: 123-145 23 December 1983

For cultural reasons, these images have been removed.
Please contact Auckland Museum for more information.

Figs. 1,2. The Ngataringa Bay godstick. Auckland Museum. 40009.

NAMED GODSTICKS

Godsticks for which names have been recorded previously comprise a set and individual items, possibly from a further set, collected by the Rev. Richard Taylor, and a set collected by the Rev. John Aldred. Further named items are contained in the Sir George Grey collection in the British Museum, London.

THE REV. RICHARD TAYLOR ITEMS

Three of the four godsticks in the set which belonged to Taylor (1855:82) are certainly those in Cambridge University Museum of Archaeology and Ethnology (see Skinner 1922; Barrow 1959).

THE SET

O.XI.40 (Z 6612). 37 cm, labelled on the back ''Hukere. Wanganui G ..... New Zealand'' and ''Hukere F.M. 9/12/84 No 3'' (Figs. 3,4).
O.XI.38 (Z 6610). 36 cm, labelled on the back as ''Maru'' and ''F.M. No 1 9/12/84'' (Figs. 5,6).
O.XI.39 (Z 6611). 35.5 cm, labelled on the back ''Kahukura'' (Figs. 7,8).

Barrow (1961:228) identifies an individual godstick now in the National Museum (Oldman 155) as the stick representing Maru in Taylor's original sketch, rather than O.XI.38 above.

A fourth stick in the group of four illustrated by Taylor (Fig. 9) is in the Pitt Rivers Museum, University of Oxford (No. P.R. 122(H)). It was formerly part of the Ashmolean Museum collection and had been purchased in 1878. The label with the figure explains its use.
''Carved figure in grotesque human form, painted red and bound with red cord (plaited fibre), into which a god was induced by incantations to enter for a time, in order that he might reply through a priest to the people's requests''. In the Taylor sketchbook referred to by Barrow (1961:228) the god represented is identified as *Rongomai*.

Attributes of the gods represented

The Taylor godsticks in Cambridge are associated with the gods Maru, Kahukura and Hukere. *Maru,* according to Skinner (1922:169) was a local god of war and Taylor (1855:81) mentions ''Karakia, used to propitiate Maru, for success in war'' or ''*Maru* is the god of War: he was killed and eaten when on earth, but his divinity flew up to heaven, and the planet Mars, from his fiery colour, is called Maru. The god has many names, as
Maru i te Aewa
'' Koeta
'' Anaunau
'' Waka tamara
'' Tahuri mai
'' Takotua
'' Tawakarere
'' Riri
'' Nguha
'' Mataitai

For cultural reasons, these image have been removed.
Please contact Auckland Museum for more information.

Figs. 3-9. The Taylor set of godsticks. 3-8. Cambridge. 3,4. O.XI.40 (Z6612). Hukere. 5,6. O.XI.38 (Z6610). Maru. 7,8. O.XI.39 (Z6611). Kahukura. 9. Pitt Rivers Museum, Oxford. P.R. 122 (H). Rongomai.

These names were descriptive of his various evil qualities: his going to and fro as an adversary; chattering defiance; looking down malignantly; causing disease; flaming with wrath; full of anger and bitterness'' (Taylor 1855:35). In other areas he is also noted as a personification of celestial phenomena, a glow in the heavens (E.Best 1982:303). Best also mentions him as replacing Uenuku, one of the rainbow gods among the Aotea people (ibid:414). He is also called ''a famed war god'' (ibid:610).

Kahukura is a personified form of the rainbow who appears as a double bow in the sky (E.Best 1924:121); he gives weather indications to man. He is also concerned with giving warning of impending death and disaster.

Hukere, also known as Hukere nui, ''was a deity connected with the scraping of bones and their deposition in tribal ossuaries'' (Graham 1923:50).

Rongomai is one of the important gods. Taylor, in his manuscript journal, has the comment ''The natives of Wanganui had many Gods, and likewise images of them, the principal of these were Maru, Kahukura, Reua Korongomai (Taylor MS:360). This latter section should read — Maru, Kahukura raua ko Rongomai, that is Maru, Kahukura and Rongomai. Taylor (1855:33) cites Rongomai as the chief god of Taupo and also as the god of consumption (ibid:34). ''. . . . each tribe had its peculiar gods. *Tu* was the great god of war in the north, and *Maru* in the south. *Rongomai* was the chief god of Taupo'' (Taylor 1855:33); who appears as a meteor or shooting star (E.Best 1924:126). Rongomai is also one of the important gods of Ngati Kahungunu (Matorohanga MS.).

INDIVIDUAL TAYLOR GODSTICKS

In Wanganui Museum there are two named examples of godsticks which can be reliably associated with the Taylor family (Barrow 1959:183). One is E 51.257 (Figs. 12,15) with a label on back with ''*Rakaiora* god of Kumara'' written in pencil (Barrow 1959, No.6, pl.3 a,b). The other is E 51.258 (Figs. 11,14) which has writing on the back in pencil ''*Pahaka*'' and a note by M.G. Smart is appended ''Pahaka son of Rongoma Tane''. (Barrow 1959, No.8, pl.4, a,b,c). There are also unnamed items (Figs. 10,13) and Fig. 16) which can now be identified (see below).

In the National Museum there is a specimen No.155 in the Oldman collection with ''*mokotiti* a New Zealand God'' written on it in similar fashion to the Taylor series (Barrow 1959:192), no. 11, pl.11, a,b,c). Other named *whakapakoko rakau* or godsticks are also associated with Taylor. A specimen held in a private collection in Huntingdon, Virginia, U.S.A. was given to G.M. Fox by Taylor. Written on the back is ''*Maru* the God of War . . .'' (Barrow 1959:190; 1959, No. 5, pl.2 a,b,c).

Attributes of the gods represented

Rakaioro, appears in the form of the green gecko, a lizard (E.Best 1982:147, 270), or *moko kakariki*, an omen of death (ibid:600), and also as a symbol of the beginning of life as seen on some carvings. Rakaioro is also the god of the kumara when being taken into store (White 1887:appendix).

Pahaka is recorded in Tregear (1891:299) and in White (1887:appendix) as a son of Rongomatane, the god superintending crops being taken into store.

For cultural reasons, these images have been removed.
Please contact Auckland Museum for more information.

Figs. 10-16. Taylor godsticks in Wanganui Museum. 10,13. E51.256. Representing Rongomatane. 11,14. E51.258. Named as Pahaka. 12,15. E51.257. Named as Rakaiora. 16. E51.262. Representing Ahupiri Kaimanga, god of the head.

Photos: National M

Mokotiti, known as the god of the chest of men (White 1887:appendix) and as a "Reptile-deity, which entering the lungs, causes consumption and pulmonary diseases" (Tregear 1891:250). Taylor says "Moko titi, a lizard god, who was the source of all pains in the breast" (Taylor 1855:34). The name written on the back of Oldman 155 does not seem to identify the god represented as Mokotiti. It is written in small letters and would suggest a description rather than a name. Mokotiti is a god but *mokotiti* is also an alternative word for *whakapakoko rakau* (Te Riria pers. comm). The god represented would seem to be Maru (ibid), and this would accord with Barrow's (1961:228) and Archey's (1960:302) opinions.

THE REV. JOHN ALDRED SET

This set consists of three *whakapakoko rakau* in Auckland Museum presented in 1921 by W.A. Aldred, son of the Rev. John Aldred who collected them in 1848 at Waimate Pa, south Taranaki.

6362. "God-stick being a representation of the Atua Maru" (Figs. 17,18).
6363. "God-stick being a representation of the Atua Tangaroa" (Figs. 19,20).
6364. "God-stick being a representation of the Atua Rongo" (Figs. 21,22).

These pieces are accompanied by letters from John Aldred and the Rev. R.G. Hammond as copied by W.A. Aldred.

> "These Maori gods, together with other Maori relics which came into my possession between forty-five and forty-seven years ago. They were procured by the catechist from the Maoris inhabiting the West Coast of the North Island, between Wanganui and New Plymouth; the information respecting them was given to me by the catechist, and by a few aged natives acquainted with the people under his charge. These gods were parted with when the Tribe embraced Christianity. Their age must be very great; for there is scarcely any perceptible difference in their appearance now as compared with their state when they first came into my hands. These gods were in the sole custody of the tohunga (priest) and were only on certain occasions, I believe, seen by others. The tohunga when invoking them would hold them up in his hand as he muttered his incantations.
>
> The superstitious regard in which these gods were held by the people was very great, as was also the person of the tohunga in whose charge they were known to be.
>
> I regret that I cannot give the names of all the gods. Two names out of the three I have quite forgotten.
>
> No. 1 This doubleheaded god, to the best of my recollection, was the god of fishing and was invoked by the tohunga when parties went out fishing. The tohunga held it up in his hand and indulged in unintelligible mutterings.
>
> No. 11 This was the most important god of the three. He was the god of war and was called Te Maru. He was similarly manipulated by the tohunga, and was resorted to in the time of war. This god was regarded with great terror, and the sight of him would fill the warriors with the wildest excitement. The cord that entwines Te Maru was of native make, and was tapu (holy). The power of Te Maru (was inside this holy cord).
>
> No. 111 This was the god of planting and like the other two was solely in the charge of the tohunga, and was invoked only by him on behalf of the people during the planting season.

For cultural reasons, this image has been removed.
Please contact Auckland Museum for more information.

Figs. 17-22. The Aldred set of godsticks in Auckland Museum. 17,18. 6362. Maru. 19,20. 6363. Rongomatane. 21,22. 6364. Tangaroa.

Photo: National Museum

Referring to what I have written about the gods I think it right to add a few qualifying words. It is so long since I came in possession of them, that I have had to hunt through my memory to supply the information I have given. My aim has been strict accuracy, and if I have in any measure failed, I must plead forgetfulness."

This letter has the following note appended to it.

"The foregoing particulars were written by my father, the late John Aldred of Chch, who came out to N.Z. in 1840 as a Wesleyan Missionary to the Maoris.

I was led to understand by my father that these Atuas in question were obtained from the Maoris of the Waimate Pa, near Opunake, Taranaki.

(signed) W. Arthur Aldred
12 Ellerton Rd,
Mt Eden,
Auckland."
29/10/1921

Extract from the Rev T.G. Hammond's letter of 11th July 1892.

"The Patea natives do not know much about the images sold or given to Mr. Hough. But doubtless Mr. Hough (The catechist from whom . . . . obtained the articles) got correct information at the time he purchased them, in which case:—

No. 1 would be either Tangaroa or *Turanga*. The former was the atua to whom incantations were offered before fishing expeditions at sea, but Turanga was the god of the river.

No. 2, Maru, was the most important atua of this people — in fact the atua of the Aotea migration. Maru came to this land in Aotea under the name of Tapo, the person who was insolent to Turi and was thrown overboard, but taken on board again because, by his fearless behaviour, the people saw that the great spirit Maru was in him, and from that time Maru became the most important atua of the Aotea migration — which comprised the Ngatiruanui, Ngatimaru, Ngarauru, Whanganui, Ngatiapa, Rangitane, and Mua upoko tribes, with some of the Ngatiawa and Whaka to hea of the East Coast. These tribes kept images (wood) of Maru, some of which are among Ngatiruanui till this day; others were given away or burnt at the introduction of Christianity, and I have no doubt that the one in your possession was a veritable *atua whawhai* of this people.

No. 3, will be Rongo, as the descendants of Turi always offered incantations to Rongo in order to secure good crops.

Should I get more information I will gladly forward it, but I find my people, who have lately very earnestly returned to the gospel, not at all willing to talk or think about these atua — *kino tito*. They seem strangely bitter against all *tikanga Maori,* and speak of these atuas more as actual personalities who have done great wrong to them and their people in the past. A Maori told me the other day that all the Maori gods of old were bad — not one good among the many."

This letter extract is accompanied by the following.

"I certify that the foregoing is a correct copy of the extract of the letter received by my father, the late John Aldred, Wesleyan Missionary, of Chch, from the Rev T G Hammond of 11 July 1892.
W Arthur Aldred
12 Ellerton Rd,
Mt Eden
Auckland."
29/10/1921

Attributes of the gods represented

In the Aldred set the names given are fairly straightforward although there is some doubt as to which they refer. 6362 is certainly Maru (Figs. 17,18), the great god of the Aotea. S. Percy Smith (1910:220) quotes Rangipito, a learned man of Te Atiawa.

> "That he was principal god of Taranaki, indeed of all the descendants of those who came in the "Aotea", as also of Ati Awa. This god was brought over by Turi in the "Aotea" as a spirit, not an image, and the priests on board were those of Maru. He was an evil god, who was very particular as to the behaviour of his worshippers, who were never to quarrel among themselves, and always to be on good behaviour. He was their god of war, to whom *karakias* were addressed and offerings made . . . Rev. Mr Hammond has a note "The stone image of the god Maru, which the Patea people formerly possessed, was burnt by Tamate Te Ito, and his *ope whakanoa* (or party who took the *tapu* off the *pas* etc. in the year 1855. Te Ito is still alive, a very old man, at this date, 1906). The stone broke in pieces when burnt. The distinguishing name of the people who had it in charge was Wai-o-tuere. Tapo of the "Aotea" canoe was Maru's particular priest, and it remained in charge of his descendants from that time till burnt".

Among Te Atiawa, the Aotea tribes and those of the northern South Island and Chatham Islands today, Maru is regarded as a sea god to whom the first fish caught are always given. This was probably his primary function before he became a war god.

A double-headed deity (6363) (Figs. 19,20) is almost certainly what E. Best calls the dual deity (E.Best 1924:111), a coupling together of the attributes of Rongo and Tane; Rongo as god of harvests and Tane as god of vegetation — Rongomatane.

Tangaroa is depicted in the remaining stick with a single head (6364) (Figs. 21,22). These identifications reverse the order given in the museum catalogue for these numbers. A photograph in the Gilbert Archey Annotated Photo Archive in the Ethnology Department of Auckland Museum correctly identifies the gods represented. It was made before 1921 when the godsticks were still in "the possession of W.A. Aldred of Timaru".

OTHER INDIVIDUAL ITEMS

In the British Museum there are three godsticks. One in the Sir George Grey collection 54.12-29.15 (Fig. 23) and two others 63. 2-9.6 (Fig. 24) and 63. 2-9.7 (Fig. 25) which belong together.The two former figures are said to represent Maru but as both are quite different this would not be true. Taylor's *Te Ika a Maui* published in 1855 would appear to be responsible for some of the museum notation. The Grey item was received in 1854 and the other in 1863, so that the Grey godstick could be a correct attribution predating Taylor. As will be seen (refer Appendix below), the Grey attribution is correct while 63. 2-9.6 represents Tangiora, a local god of war from the Pamoana hapu of Koroniti on the Wanganui River, while 63. 2-9.7 represents Pahaka, a god of agriculture.

There is a further Sir George Grey collection godstick in Auckland Museum (No. 21,894 (Fig. 26) which represents Tangaroa and may have been part of a set with the British Museum example (54.12-29.15).

For cultural reasons, these images have been removed.
Please contact Auckland Museum for more information.

Figs. 23-26. Godsticks. 23-25. British Museum. 23. 54.12-29.15. Grey collection. Maru. 24. 63.2-9.6. W.A. Franks. Tangiora. 25. 63.2-9.7. W.A. Franks. Pahaka. 26. Auckland Museum. 21894.3. Grey collection. Tangaroa.

Photo (Figs. 23-25): British Museum

THE ASSOCIATIONS OF THE GODSTICKS

The named sets of *whakapakoko rakau* are, as Skinner noted in 1922, usually in sets of three (Skinner 1922:172). The Taylor set are identified in Cambridge as Maru, Kahukura, Hukere, with the alternative image in Oxford identified as Rongomai. This set is correctly characterised by Gathercole (1979:288) as a set of tribal gods. ''The godstick ritual is not only very systematic and controlled but also extremely flexible'' (ibid:289). It was flexible to a certain degree in that alternative gods could be substituted in a set. It was also varied in the carving styles employed. These latter followed the tribal art forms. The representation of the same figure in different areas could vary although I am assured that the *tohunga* could recognise a representation regardless of how it was portrayed. The main barriers to identifying the various *atua* forms in the sticks, as in other portrayals, is lack of knowledge combined with incorrect identification of some god symbols. Barrow's broad delineation of a Wanganui - Taranaki style of carving (Barrow 1959: 1961), obscures rather than assists in identifying the difference.

The *whakapakoko rakau* sets can also be called *tiki* as they are in human form. They are not the special *toko wananga* described by White (1887:2) used when the *whare wananga* schools were meeting. These represent the major gods characterised by Best as ''departmental gods'' (E.Best 1924:86). The reduction of the symbol of the god to a single design as in these *toko* is an indication of the symbols to be identified on the *whakapakoko rakau*. There is a set of *toko wananga* (Fig. 27) in the Sir George Grey collection in Auckland Museum (21892.1-6) collected near Mauku, just south of Auckland. Tumatauenga is represented by a straight *toko*, Tawhirimatea by a corkscrew, Tane by a semi-circle, Tangaroa by a zigzag, Rongo by rounded waves and Haumia by three small half-circles. Despite Te Rangi Hiroa's caution (Te Rangi Hiroa 1949:467) the Grey set must be presumed to be of pre-European manufacture as they were hidden before the Ngapuhi raids of 1822.

Many of the gods depicted are specifically stated to have been brought into the tribal area from Hawaiki. Maru, Kahukura and Rongomai were brought from Hawaiki in the story of Manaia in *Nga Mahi a Nga Tupuna* (Grey 1928:71) in the passage written by Matene Te Whiwhi of Ngati Raukawa. Pita Kapita of Ngati Porou associates Kahukura with the Horouta canoe and with the Takitimu canoe of Ngati Kahungunu (Simmons 1976:121, 129), and Kahukura is also the main god of Ngai Tahu, corresponding to Uenuku, Maru and Rongomai of Arawa (Cowan 1910:109). In 1910 Te Heuheu Tukino of Tuwharetoa gave Rongomai, Uenuku, Kahukura, Tawhai, Puhaorangi and others as tribal gods but Rongomai (Figs. 28,29) was also his personal god as *ariki* of Tuwharetoa (Cowan 1910:109). Uenuku and Kahukura are both gods of the heavens who are seen as rainbows, and are to a certain extent, interchangeable. Uenuku is both tribal and war god of Waikato and north Taranaki (Cowan 1910:109). Te Rangi Hiroa (1949:461) considered it likely that the gods brought from Hawaiki were Maru, Kahukura, Uenuku and Rongomai. Kahukura was a god and also an ancestor of Rarotonga as was Uenuku (ibid:461). In Rarotongan traditions, Tangaiti, Tangaroa, Ruenuku, Tane, Tu, Rewa, Rongomatane and Rongo are referred to in the story of Maui (Gill 1916:124). This also indicates that White's classification (White 1887:appendix) of Rongomatane as a son of Rongo has some antiquity.

For cultural reasons, this image has been removed.
Please contact Auckland Museum for more information.

Figs. 27-29. 27. *Toko wananga*. Auckland Museum. 21892.1-6. Left to right. Rongo, Tangaroa, Tawhirimatea, Tu, Tu, Haumia. 28,29. Godstick. Canterbury Museum. E149.17. Rongomai.

Photos (Figs. 28,29): National Museum

The pointed form of the *whakapakoko rakau* is also known from Polynesia. It was present in central Polynesia and very general in Hawaii (Te Rangi Hiroa 1949:472). Barrow (1961:218) illustrates a Hawaiian crested godstick with human head at one end and a point at the other. The shaft of the stick is decorated with incised patterns similar to the lashing found on New Zealand images and also on ceremonial adzes from Mangaia (Te Rangi Hiroa 1949:469-70).

The triple sets of godsticks can be compared with other expressions of Maori art such as lintels which also incorporate the same principle. "This argument suggests that due to the basic trinary structure of the symbolism of Maori carving (and so of Maori life), godsticks could have been organised in trinary sets. Such an arrangement conformed to an ideological "ideal" (Gathercole 1979:291). The ideal in question lies not in the artistic sphere but in the spiritual — in the cosmology which is seen as the very structure of the universe and of social life and values. The functions of the sets perhaps best illustrate this ideal.

THE SETS AND THEIR FUNCTIONS

The Taylor set from Wanganui includes the three named respectively Maru, Kahukura and Hukere, who are gods concerned with the sea and war, the heavens, the earth and death. The fourth stick Rongomai would replace Maru in some Tuwharetoa rituals and Kahukura in others.

The Aldred set from Waimate Pa is a set applying to the sea. Maru again is a sea and war god, Tangaroa is concerned with the life in the sea, and Rongomatane in this sense is concerned with seaweed and the life just at the top of the water — he is half submerged. The life in question is food for fish and men. In our understanding, it would be labelled plankton.

Two of the individual Taylor godsticks in Wanganui Museum are labelled Rakaiora and Pahaka. They would be associated with Rongomatane in a set concerned with the kumara, as Rongomatane is associated with growth, Pahaka with lifting and curing of the tubers, then their transport into storage. Rakaiora is a god who looks after the putting into store.

The godstick named Mokotiti is part of a set concerned with the human body. The god of the head is Ahupiri Kaimanga, the god of the flesh is Waihoetoto, and the penis is cared for by Tikitikipono. An alternative set for the body when illness strikes would include Mokotiti instead of Waihoetoto. Mokotiti in his *aria* of a lizard is inimical, on the one hand he causes diseases of the lungs but on the other more positive side he allows the body to be upright, healthy and straight.

There are two further sets of *whakapakoko rakau* for which as yet few clearly identified examples have been found. A general set concerned with the earth and its life would consist of Takuru who makes the dew and soil moisture to give life to growing things; Heketurongo who is concerned with soil fertility and Waitangikanga who watches over the seasons and shelters the plants. An earthly set whose gods watched over food-bearing trees consisted of Kairongo watching the fruit spurs and the bearing of the crop, Ipo protecting the bark of the tree and Nga Houhou concerned with rebirth, growing of seeds and regeneration. This knowledge is derived from information given to the author by a knowledgeable elder, Te Riria, a graduate of Te Ariki-mohowhakaitiiti *whare wananga*.

As the sets of *whakapakoko* are in threes, it would seem they represent the three realms, Te Kore, Te Po and Te Ao Marama (Marsden 1975:191). In the letters of Thomas Kendall from the Bay of Islands in 1824 (Binney 1968:172), reference is made to the six principles of existence, united in the seventh. There are said to be six sets of *whakapakoko rakau* which are united under the seventh or spiritual set which could only be invoked by the *arikinui* or *taiopuru*. A cognate word, *tapairu* refers to a first born female in a family of rank and in the term *kai tapairu*, sacred food to be eaten only by an *ariki* in the eldest line of descent (Williams 1971:382).

These spiritual *whakapakoko* are the Koroiti Ko Tama, the highest(Binney1968:172) which can be defined as the spiritual life force of the world from which all is created. This is in Te Kore the first state of existence. The Koroiti Ko Tama is not a supreme being in the European sense — it is a life force. Its material representation is the *tokipoutangata* Iriperi Ko Tama an archaic and sacred adze (Fig. 30) made of Tahanga basalt held on deposit in Auckland Museum (No.47156) (S.Best 1977:331).

The second spiritual *whakapakoko* is Ahupiri, the spiritual teachers who maintain the universe in the ten heavens. These are the gods Rehua, Tawhaki and Maru. Maru looks after the lowest three heavens, Kiko Rangi, Whakamaru and Nga Roto. Tawhaki (Fig. 31) has charge of the next three heavens, Hauoro, Nga Tauira and Nga Atua. The latter is the abode of the inferior gods. Rehua is supreme in the four uppermost heavens. Autoia, Aukumea, Wairua and Tuwarea of Toi o Nga Rangi. These and those above are the names as given by White (1887:appendix). These are the correct sacredotal names whereas those given by Elsdon Best (1924:42) derived from the teachings of Matorohanga, would not seem to have been more than descriptive or numerical. The same can be said of the list given by Taylor (1855:17).

It will be noted that Maru reappears again, not as a war or sea god of Wanganui and Taranaki, but as a great god in his own right. This is the form in which he appears in the Taylor set even though Taylor (1855:35) is confused and quotes his attributes as ‘‘God of the Heavens’’.

The third *whakapakoko* of the spiritual set is the Taiopuru (Fig. 32) the guardian and protector of the Koroiti Ko Tama in Te Ao Marama, this world. In the person of the eldest male of the *ariki* line he is a man or, if no male is available, the senior female or *tapairu* fulfils this function.

CONCLUSION

The Ngataringa Bay godstick (Figs. 1,2) is of the Hukere form. The godsticks were made and used in sets of three by the *tohunga* on certain occasions and sometimes an alternative set was used. Information from the named godsticks plus information from a trained elder has been put together to explain the numbers and functions of these sets.

1 The supreme spiritual set which encompasses the others and deals with the three realms of existence is Koroiti Ko Tama, Ahupiri, Taiopuru.

For cultural reasons, these images have been removed.
Please contact Auckland Museum for more information.

Figs. 30-32. 30. *Tokipoutangata*. Auckland Museum. 47,156. Iriperi ko Tama. 31,32. Godsticks. 31. National Museum. Webb 1838 (collected J. Cook 1770). Tawhaki. 32. Auckland Museum. 3453. Taiopuru.

2 A general set is Maru (alternative Rongomai), Kahukura, Hukere.

3 A set for the sea is Maru, Tangaroa, Rongomatane (Fig. 33).

4 A set for the earth is Takuru, Heketurongo (alternative Ngairakau), Waitangikanga.

5 A set for food-bearing trees is Kairongo (Fig. 34), Ipo (alternative Moetiti), Ngahouhou.

6 A set for kumara comprises Rongomatane, Rakaioro, Pahaka (alternative Waihuru).

7 A set for the body is Ahupiri Kaimanga (alternative Waipuna), Waihoetoto (alternative Mokotiti), Tikitiki pono (Fig. 35) (alternative Ngapururu).

The seven sets do not preclude invocation of other departmental, tribal, family or deified ancestors, many of which are represented by *taumata atua* of various sorts. For example, Pani the goddess of kumara in store is represented by a stone figure or *mauri*.

The presence of *whakapakoko rakau* from Ngataringa Bay within the former Kawerau tribal territory would suggest that such items were more widespread in the past than present distribution would suggest. Like the Taylor sticks, those in other areas would have been hidden or perhaps destroyed when the people became Christians.

For cultural reasons, these images have been removed.
Please contact Auckland Museum for more information.

Figs. 33-35. Godsticks. 33. Otago Museum. D24.1260. Rongomatane. 34. Cambridge. 22.1533. Kairongo. 35. Auckland Museum 37,148. Tikitiki pono.

APPENDIX

List of known whakapakoko rakau

In 1959, 1961 and 1974, Barrow described and illustrated all the *whakapakoko rakau* he could locate at that time. Further information has been provided by Archey's notes in Auckland Museum and my own records of Maori collections in the United States of America, Canada and Europe. Where the origin of a piece and/or its name have been recorded previously, these are printed in bold type. A suggested tribal style attribution is made for unlocated pieces. Identification of the unnamed pieces has been made by comparison with named examples in consultation with Te Riria. Each such identification has been printed in ordinary type.

It will be noted that some sticks from Barrow's lists have been omitted. These are not godsticks. On the other hand, two items excluded by Barrow, e.g. Auckland 3453, 37148 (Barrow 1974, figs. 197-8, 199) described as batons have been included. The items excluded are: Otago Museum D38.1245 from Wickliffe Bay (Barrow 1961, no. 24), National Museum Web. 1776 (Barrow 1961, no. 25) which is a boundary or survey peg, National Museum 3055 (Barrow 1961, no. 26) a weaving peg, and Wanganui Museum 51.359 (Barrow 1959, no. 10) which is a peg used to mark the eastward facing area when a new house area is being dedicated. Additional items are included from Auckland Museum and the Staatlichs Museum für Volkekunde in Dresden, D.D.R.

Museum	Catalogue No.	Length	Tribe & Locality	Name	References	Remarks
Auckland	47156	36 cm	Nga Herehere, Wairoa	Iriperi Ko Tama	S. Best 1977 86:331	Tokipoutangata
National	Web. 1838	51.5 cm	Ngai Tahu, Prob. Qn. Charlotte Snd.	Tawhaki	Barrow 1961, No. 27.	Carved by a *Gisborne* carver, complete human figure.

Auckland	3453	45.5 cm	Ngati Kahungunu, **Hawkes Bay**	Taiopuru	Barrow 1974 pl. 197-8. J.P.S. 34:385-6.	Complete human figure with mask on base.
Auckland	6362	24.5 cm	Taranaki, **Waimate**	**Maru**	Barrow 1961, No. 19.	Wrapped with twisted cord
Auckland	6363	31 cm	Taranaki, **Waimate**	**Rongomatane**	Barrow 1961 No. 20	Janus with plaited cord.
Auckland	6364	31.5 cm	Taranaki, **Waimate**	**Tangaroa**	Barrow 1961 No. 21	Wrapped with plaited cord.
Cambridge U.K.	O.XI.38	36 cm	Ngati Hau, **Wanganui**	**Maru**	Barrow 1959 No. 4.	Shaft broken. Taylor 1855:82.
Cambridge U.K.	O.XI.39	37 cm	Ngati Hau, **Wanganui**	**Kahukura**	Barrow 1959 No.3.	Shaft wrapped with plaited cord.
Cambridge U.K.	O.XI.40	36.5 cm	Ngati Hau, **Wanganui**	**Hukere**	Barrow 1959 No. 2.	Head with hands
Oxford U.K.	P.R. 122 (H)	30.5 cm	Ngati Hau, **Wanganui**	**Rongomai**	Barrow 1959 No. 1.	Shaft wrapped with plaited cord.
British Museum	54.12-29.15	35 cm	Nga Rauru, S.Taranaki	**Maru**	Barrow 1959 No. 14	Grey collection
Auckland	21894.3	36.5 cm	Nga Rauru, S. Taranaki	Tangaroa	see above	Grey collection
British Museum	63.2-9.6	35 cm	Ngati Hau, Koroniti	Tangiora	Barrow 1959 No. 12	Note carving on shaft
British Museum	63.2-9.7	37 cm	Ngati Hau, Koroniti	Pahaka	Barrow 1959 No. 13.	Local war god.
Wanganui	E51.257	33 cm	Nga Rauru, S.Taranaki	**Rakaiora**	Barrow 1959 No. 6.	Harper collection ex Taylor.
Wanganui	E51.256	41 cm	Ngati Rauru, S.Taranaki	Rongomatane	Barrow 1959 No. 7.	As above, for use of *tapairu* line.
Wanganui	E51.258	23.5 cm	Ngati Hau, Wanganui	**'Pahaka**	Barrow 1959 No.8	Harper Collection
Wanganui	E51.262	36 cm	Ngati Hau, Wanganui	Kaimanga	Barrow 1959	Harper collection
Private U.S.A.		33.5 cm	Ngati Hau, **Wanganui**	**Maru**	Barrow 1959 No. 5.	Carving later than others
Canterbury	E 149.171	30.8 cm	Ngati Hau, Wanganui	Rongomai	Barrow 1961 No. 16.	Wrapped plaited cord.

Peabody, Salem, Mass.	E19.166	30.8 cm	Ngati Porou, E.Coast	Maru	Barrow 1961 No.17	Carver from East Coast
Dresden D.D.R.	26.196	34 cm	?Ngati Apa, Wanganui	Maru	—	Carving varies.
Dresden D.D.R.	25.924	34 cm	Tuhoe, Bay of Plenty	?Maru	—	Plain, painted orange ochre, 19th century
Ipswich U.K.	—	31 cm	Ngapuhi, Northland	Tangaroa	Barrow 1961 No. 18.	Incipient janus on shaft
National	Old.155	32 cm	Ngati Hau, Wanganui	*?mokotiti* Maru	Barrow 1959	Probably in Taylor's sketch.
Cambridge U.K.	22.1533	25.5 cm	Ngati Hau, Wanganui	Kairongo	Barrow 1959	Five rounds of cord on shaft.
Otago	D24.1260	33 cm	Ngai Tahu, **Moa Flat, Otago**	Rongomatane	Barrow 1961 No. 23	Janus head
Auckland	37,148	34 cm	Waitaha, **Te Puke**	Tikitikipono	Barrow 1974:143	Archaic
Auckland	45,592	15 cm	Archaic, **Katikati**	Tangaroa	Simmons 1973	cf Cook Islands
Auckland	49009	44 cm	Kawerau, **Devonport**	Hukere		
Otago	L75.6	14.7 cm	Ngati Mamoe, **Fiordland**	?		Head, plain
National		34.3 cm	Muaupoko, Horowhenua	?Ipo	Adkin 1948:96 fig. 107	Waterworn
?Waikato		—	Ngati Apakura, L.Mangakaware?		Bellwood 1978	Very worn, doubtful
Wanganui	51.261	31 cm	Nga Rauru, Waverley	Nga Ko	Barrow 1974:28, fig.19 Downes 1932:56, fig 12A, 13A	Handle-shape with bird on back Used by *tohunga* when planting special food plot.
Wanganui	51.260	42 cm	Nga Rauru, Waverley	?	Downes 1932:56, fig.12B, 13B	
Unknown (cast only)		76 cm	Ngai Tahu, Akaroa	?	Cast in Otago Museum and Okains Bay Museum.	Waterworn

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THREE SQUARE PIANOFORTES IN THE AUCKLAND INSTITUTE AND MUSEUM

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Abstract. Three nineteenth-century pianofortes are described, their constructional details tabled and summarised as illustrative of various aspects of early pianoforte manufacture, and dates of manufacture estimated. The New Zealand historical background is included for one instrument.

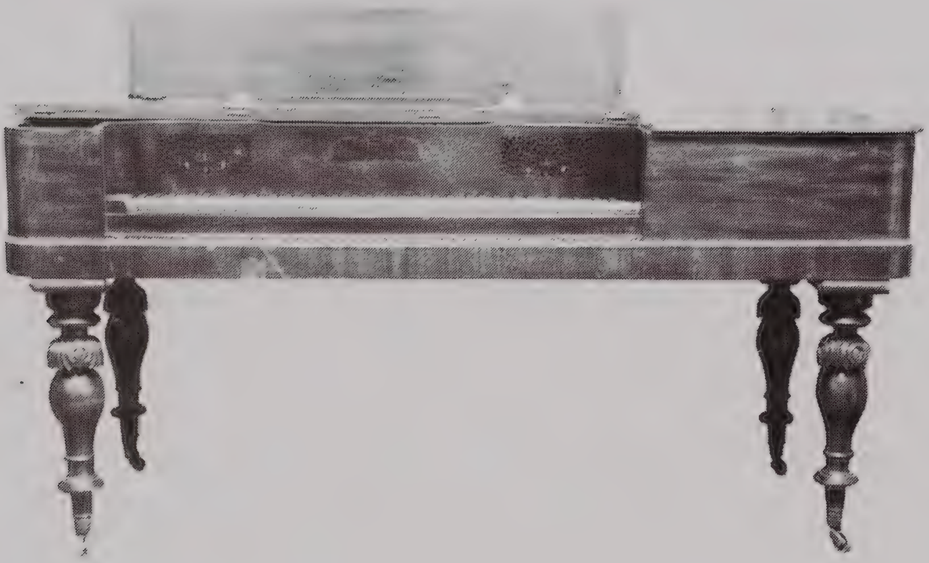
All three instruments are of the English square variety popular in the first half of the nineteenth century. These pianofortes, which were actually oblong in shape rather than square, had developed side by side with the grand pianoforte after the inventions of Bartolommeo Cristofori in the early eighteenth century. But while the grand pianoforte continued to develop, the square was gradually superseded by the vertically-strung upright instrument. Thus, by 1851, according to Grover (1976:139), the square pianoforte was "virtually obsolete"

Each of the three present instruments comprises (a) a polished wood case having four ornamental polished wood legs screwed into the base at each corner and a single pedal leg similarly screwed in near the centre rear of the instrument, the whole forming a table-type piece of furniture (Figs.1,3,5); and (b) the interior components consisting of keyboard, pianoforte mechanism, soundboard, strings, and supporting framework (Figs.2,4,6).

Background details of the instruments' history in New Zealand are known for only one of the examples. By coincidence, however, all three are products of an old-established English firm earlier known as Clementi and Co., which is the title on the nameboard label of the earliest example (see Fig.7). The firm's later name of Collard and Collard is the nameboard title of the two later examples (Figs.8,9).

The instruments are of similar design and construction, indicating a standard production-type. The three span possibly a quarter of a century, and provide within that period valuable details of various stages in the development of English pianoforte manufacture before 1850. Although it has not been possible to ascertain the precise date of each instrument, manufacturers' numbering and changes of title in nameboard and interior labels have enabled the establishment of a definite order of manufacture. It is proposed here to classify the pianofortes in this chronological order as Examples 1, 2 and 3 respectively, and to set out details of the construction, manufacture, and condition of each in Tables 1-3. Following a discussion of findings, possible dates for the instruments will be set out in Table 4; note will also be made of the action of early pianofortes with reference to the present examples. Terms for pianoforte parts and notational symbols used are explained by a diagram in Appendix 1. Appendix 2 gives the historical background of Example 2.

Rec. Auckland Inst. Mus. 20: 147-163 23 December 1983



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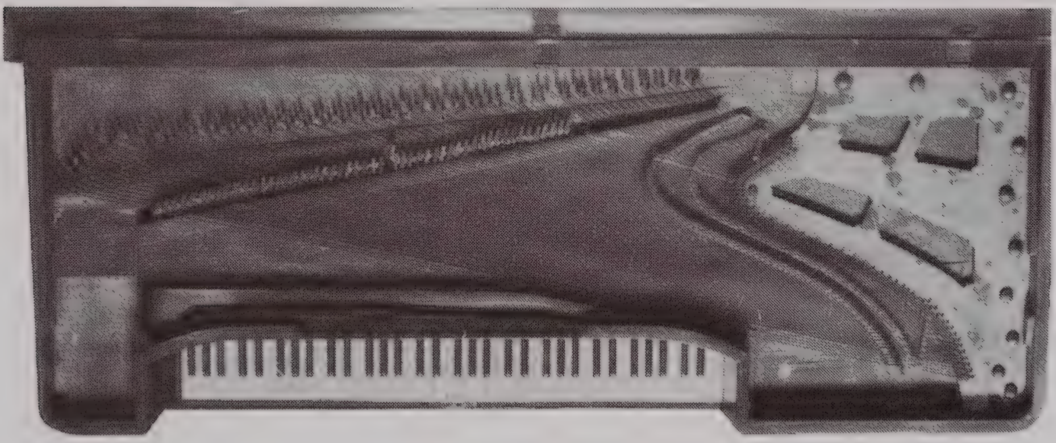

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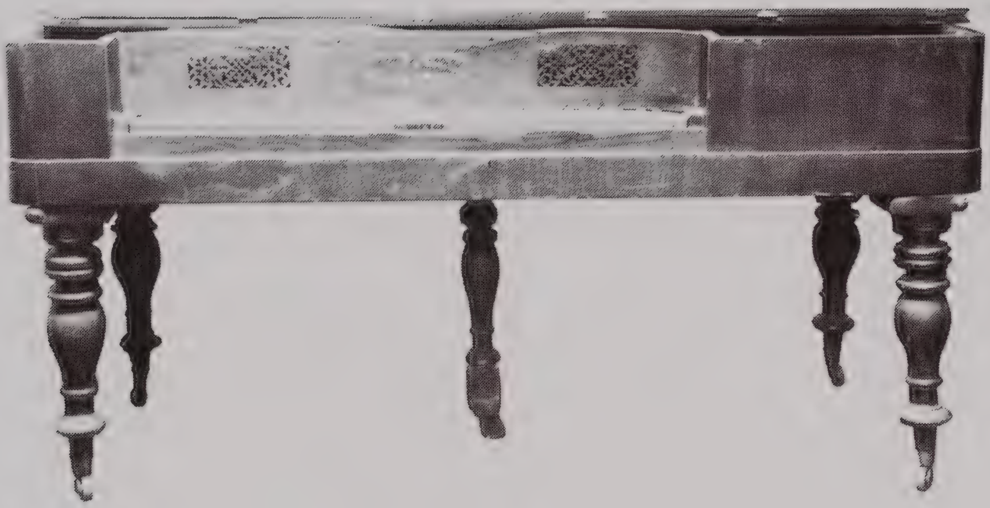
Figs.1,2. Example 1. Square pianoforte by Clementi. 1. Exterior view with front flap and lid section open. 2. Interior of case.

Photos: Auckland Institute and Museum

Table 1. Details of Example 1, square pianoforte by Clementi.

Part	Fig.	Details
Case	1	Mahogany. Single row of ornamentation around front & sides, below keyboard. Fretwork panels each side of nameboard label, green cloth behind. Depth without lid, 28.6 cm. Lid, length 180.3 cm, breadth 69.8 cm.
Legs	1	4, circular tapering, leaf scroll ornamentation at top. Height from castor, 57.1 cm. 1 pedal leg of similar design, missing in Fig.1.
Keyboard	1,2	6-octave compass, F_1 - f^4. Key surfaces badly yellowed. Woodmoulding on key fronts. Key-to-key length, 100.3 cm, with wood at bass end, 104.1 cm.
Nameboard label	1,7	Patent, Clementi & Compy., London. Black background, gold Gothic lettering, gold cartouche of leaf motifs, lyre figures each end.
Hitchpin plate	2	Brass, perforated with 4 irregular slots. Fixed with 11 semispherical bolts, 1 nutted bolt inner edge.
Braces, struts. suspension bars	—	—
Wrestplank	2	Dark wood, discoloured, some borer.
Soundboard	2	Dark wood, splits & warping.
Bridge	2	Wood, 1 division treble end.
Stringing	2	12 single strung overspun decreasing in thickness, remainder double strung.
Dampers	2	52 overdampers, up to $g\#^2$, single felt pad mounted with wood slat. Some deterioration in felts, and evidence of repair work. 21 treble strings undamped.
Hammers	*	Small heads decreasing in size from bass to treble, centre wood core covered 1 layer each of leather, material and felt. Lowest bass head leather & felt only. Repair work on lowest bass hammers. Check pad.
Manufacturer's marks & nos.	*	1580 incised upper left area of wrestplank. 25302 handwritten below. F49 incised on wood framing bass end of keyboard. 49 incised inside edge of front keyboard flap. Handwritten letter names of notes next to wrestpins. Name "T. Jobson" stamped below wrestplank end of lowest bass string.
Interior label	*	Affixed between bass end of keyboard and side of case. Heading, Directions for Taking out the Mechanism of the Patent Grand Square Piano-Forte. Text, as in Fig.10. Address, Collard & Collard, late Clementi, Collard & Collard, 26 Cheapside, 195 Tottenham Court Road, London.

*Scarcely or only partly visible in Fig.2.



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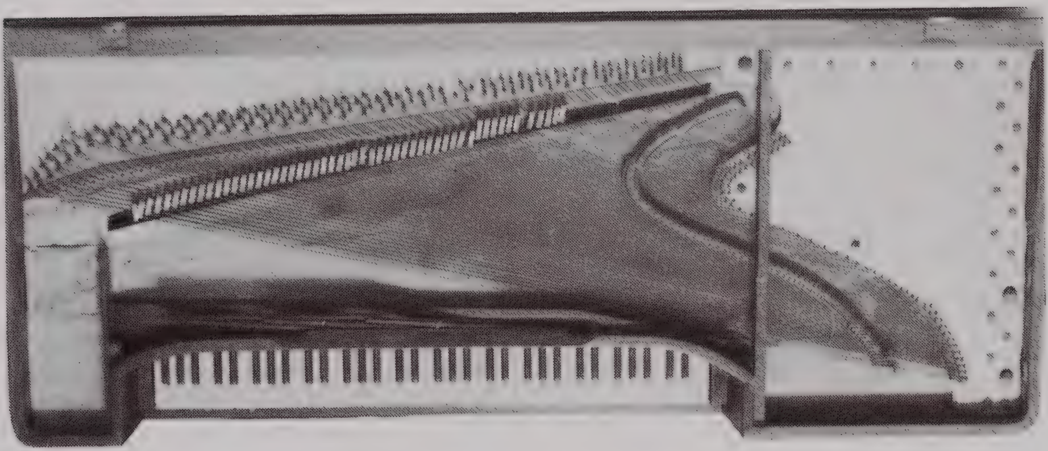

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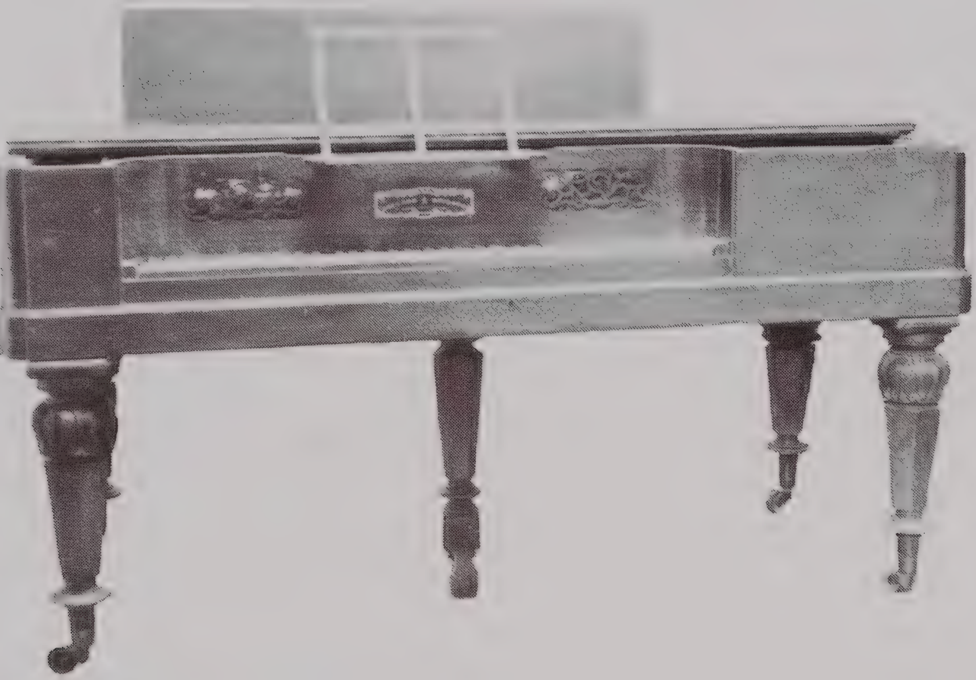
Figs.3,4. Example 2. Square pianoforte by Collard & Collard. 3. Exterior view with lid section open (front flap missing). 4. Interior of case.
Photos: Auckland Institute and Museum

Table 2. Details of Example 2, square pianoforte by Collard & Collard.

Part	Fig.	Details
Case	3	Mahogany. Fretwork panels either side of nameboard label as in Ex.1 but of different design, blue cloth behind. Lid detached from hinges at back of case. Lid flap over keyboard front missing. Depth without lid, 29.2 cm. Lid, length 181.6 cm, breadth 75.2 cm.
Legs	3	4, circular tapering, circular banding at top. Height from castor, 57.1 cm. 1 pedal leg of similar design.
Keyboard	3,4	6-octave compass, F_1 - f^4. Keys discoloured, surfaces and front edges badly worn in centre section. Wood moulding on key fronts, some pieces missing in centre area. Key-to-key length, 101.6 cm, with wood each end, 107.3 cm.
Nameboard label	3,8	Patent, Collard & Collard, Late Clementi, Collard & Collard, London. Black background, gold capital lettering, gold cartouche of leaf and pineapple motifs.
Hitchpin plate	4	Brass. Extended at rear to meet treble end of wrestplank. Fixed rear edge with 6 slotted screws and side edge with 15 slotted screws & 2 semispherical bolts. 1 semispherical bolt near wrestplank. 2 nutted bolts on inner edge.
Braces, struts, suspension bars	4	Wooden bar at right angles to keyboard extending from side of keyboard frame at treble end to back of case. Length 64.8 cm, breadth 1.9 cm, depth 2.5 cm.
Wrestplank	4	Wood, light-coloured, varnished.
Soundboard	4	Wood, amber-coloured, varnished, cracks and warping.
Bridge	4	Wood, 2 divisions treble end
Stringing	4	12 single strung overspun in bass decreasing in thickness, remainder double strung.
Dampers	4	53 overdampers, up to a^2, 3 layers of cloth, 1 coloured at base & 2 white, mounted with wood slat. Some deterioration in damping materials. 20 treble strings undamped.
Hammers	*	Small heads, centre wood core covered 1 layer each of leather, material, & felt, except e^1 - e^3 where felt replaced by thinner dark grey covering. Hammers smaller after e^3. Some moth damage in bass. Check pad.
Manufacturer's marks & nos.	*	6848 incised upper left area of wrestplank, 39000 handwritten below. F368 incised on wood framing bass end of keyboard. Handwritten letter names of notes next to wrestpins. Name "Winkworth" stamped below wrestplank end of lowest bass string.
Interior label	*	Detached from space between bass end of keyboard and side of case. Damaged. Heading, Directions for Taking out the Mechanism of the Patent Grand Square Piano-Forte. Text, as in Fig.10. Address, Collard & Collard, late Clementi, Collard & Collard, 26 Cheapside, 195 Tottenham Court Road, London.

*Scarcely or only partly visible in Fig.4.



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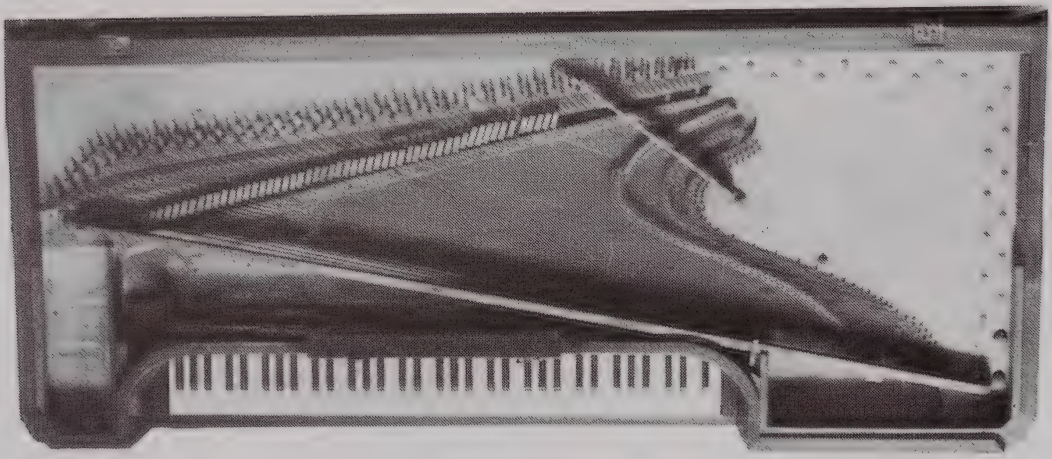

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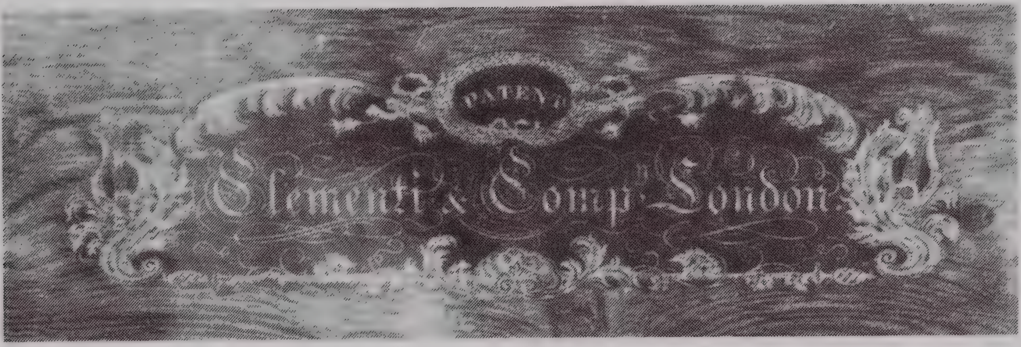
Figs.5,6. Example 3. Square pianoforte by Collard & Collard. 5. Exterior view with front flap and lid section open. 6. Interior of case.
Photos: Auckland Institute and Museum.

Table 3. Details of Example 3, square pianoforte by Collard & Collard.

Part	Fig.	Details
Case	5	Mahogany. Fretwork panels either side of nameboard label, of coarse design, blue cloth behind. Lid detached from hinges at back of case. Depth without lid, 32.4 cm. Lid, length 181.6 cm, breadth 76.2 cm.
Legs	5	4, 6-sided, flat-surfaced tapering, coarse leaf scroll ornamentation at top. Height from castor, 57.8 cm. 1 pedal leg of similar design.
Keyboard	5,6	Extended 6-octave compass, F_1 - g^4. Wood moulding on key fronts but pattern not apparent above keyboard frame. Key-to-key length 104.1 cm, with wood each end 109.2 cm.
Nameboard label	5,9	Patent Repeater, Collard & Collard, Late Clementi, Collard & Collard, London. Black background. Gold capital lettering and cartouche as in Ex.2 except for change in pattern on top border to accommodate words Patent Repeater.
Hitchpin plate	6	Brass. Fixed rear edge with 12, and side edge with 15, slotted screws. 2 semispherical bolts side edge, 1 nutted bolt inner edge.
Braces, struts, suspension bars	6	Square-sided metal suspension bar bolted from hitchpin plate to wrestplank over treble strings. Length 36.2 cm, breadth 0.8 cm, depth 2.2 cm. Longitudinal square-sided metal brace bolted from lower corner of hitchpin plate to wrestplank parallel to lowest bass string. Length 165.7 cm, breadth 1.6 cm tapering to 0.9 cm, depth 3.5 cm.
Wrestplank	6	Wood, light-coloured, varnished.
Soundboard	6	Wood, light-coloured, discoloured, varnished. Grain diagonal to keyboard.
Bridge	6	Wood, 2 divisions treble end.
Stringing	6	12 single strung overspun in bass decreasing in thickness, remainder double strung, 1 broken string near centre register.
Dampers	6	53 overdampers, up to a^2, 3 layers of cloth, 1 coloured at base & 2 white, mounted with wood slat. 22 treble strings undamped.
Hammers	*	Small heads decreasing in size from bass to treble, centre wood core covered 1 layer each of leather, material, and felt. Check pad.
Manufacturer's marks & nos.	*	9196 incised upper left area of wrestplank, stamped word "Patent" below, 45369 handwritten beneath. "Patent" also stamped on wrestplank near highest treble string. 9196 also incised inside edge of front keyboard flap near central hinge. Some hand-written letter names of notes visible near wrestpins.
Interior label	*,10	Detached from space between bass end of keyboard and side of case. Heading, Directions for Taking out the Mechanism of Collard & Collard's Patent Grand Square Piano-Forte. Text, as in Fig.10. No address.

*Scarcely or only partly visible in Fig.6.



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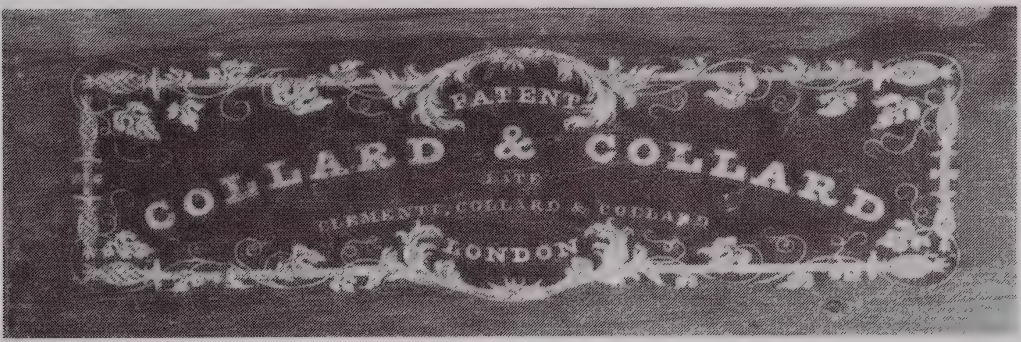

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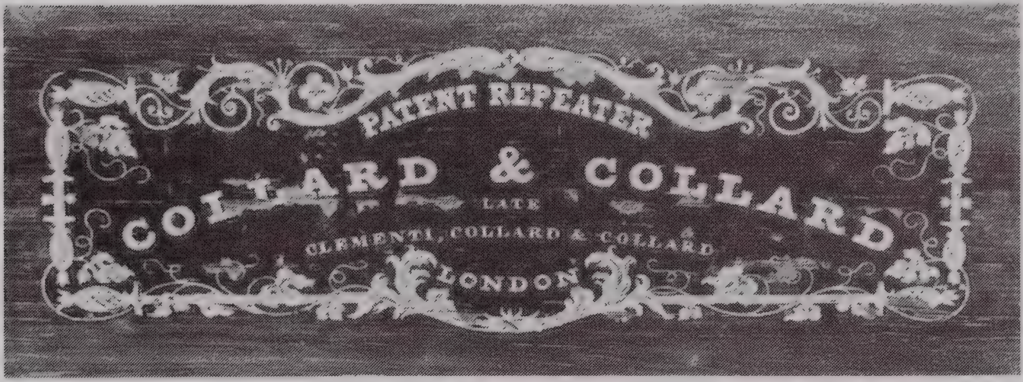

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Figs.7,8,9. Nameboard labels. 7. Example 1, Clementi & Co. 8. Example 2, Collard & Collard. 9. Example 3, Collard & Collard.

Photos: Auckland Institute and Museum.

DISCUSSION OF DETAILS, TABLES 1-3.

1. *Case.* In keeping with the nineteenth-century trend towards larger instruments, case measurements of the present examples increase slightly in order of manufacture. As seen in the illustrations of Michel (1963) square pianofortes of the eighteenth and early nineteenth century had been square-sided and more compact (also Harding 1978: 302). Although production of the square instrument declined in England after 1850 (Grover 1976: 139), its manufacture was carried on in the U.S., where, as again graphically portrayed in Michel (1963), the instruments became heavy and thickset (also Closson 1974: 101).

2. *Legs.* "The change from the taper to the lathe-turned leg marked the beginning of a decline in taste which was to go to an extreme length towards the end of the century" (Harding 1978: 302). The comment represents a viewpoint on Victorian taste not necessarily acceptable today. The heavy legs as seen in the present examples were needed to support the weight of the larger cases, and their ornate decoration illustrates the growing preference for lavishness in contrast with the plainness of the earlier instruments. In Example 3 the actual leg height has slightly increased. The single leg with foot pedal for raising the dampers had also replaced earlier handstops and various foot pedals (ibid: 264).

3. *Keyboard.* The basic six-octave F_1 to f^4 compass of each example is "continental", i.e. it is an extension of the five-octave, F to f^3 compass of the early Viennese instruments (Colt 1973: 31, Barthold & Buckton 1975: 52). Key-to-key length increases progressively over the three instruments, with Examples 1 and 2 having the same compass, F_1 to f^4, and Example 3 two extra treble notes, $f\#^4$ and g^4. Improvements by John Broadwood had made possible the production of a standard six-octave pianoforte in the 1790s (Wainwright 1975: 33). Six and a half octaves were also in use in the early nineteenth century, and even seven octaves from about 1823, although the latter compass was not common until after 1840 (Grover 1976: 209). Broadwood's 1840 offer, however, of a "Newly invented instrument . . . Grand Patent Square with six and a half octaves" (Harding 1978: 400) suggests that in instruments similar to the present examples the quoted compass range was something of an innovation. The extra two notes in Example 3 may therefore be regarded as an early step towards a gradual compass increase in this size and type of instrument. Similarly, the reduction of ornament in the wood moulding of key fronts after Example 1 may be seen as progress towards today's plain, completely covered key.

4. *Nameboard label.* In accordance with the unanimous statement of consulted references that the title of Clementi & Co. changed to Collard & Collard on Clementi's death in 1832 (Harding 1978: 406, Grove 1980,4: 483, Barthold & Buckton 1975: 48, Grover 1976: 160, Sumner 1978: 133), the Clementi & Co. title of Example 1 (Fig.7) should allow a pre-1832 dating. Examples 2 and 3 are Collard & Collard, but still carry the subordinate reference "late Clementi, Collard & Collard" (Figs.8,9), suggesting some closeness in point of time to Example 1, and to each other. Although the cartouche design changes after Example 1, a general continuity of design is apparent in the lower border of all three labels (Figs.7-9).

5. *Hitchpin plate*. The invention and use in a square pianoforte of a metal hitchpin plate, as present in the examples under discussion, is generally credited to Samuel Hervé of the firm of John Broadwood & Sons, in 1821 (Harding 1978: 200). Some experimentation with escape of sound, not repeated in the two later examples, is indicated in the perforations of the plate in Example 1. (For an illustration of a plate with circular perforations in an undated square pianoforte by Broadwood, see Harding 1978: 202,pl. III.) The plates of Examples 2 and 3 show an increased surface area with the plate extended at the rear to meet the wrestplank end.

6. *Braces, struts, suspension bars*. Thom & Allen had patented in 1820 a compensation frame consisting of metal tubes placed over the pianoforte strings (Harding 1978: 202). A later application of this to a square instrument appeared in the form of a tubular brace fixed in a similar manner to the square-sided brace of the present Example 3 (ibid: 212, pl.IV). The combination here of metal suspension bar and longitudinal brace bolted to hitchpin plate and wrestplank is a graphic foreshadowing of the complete metal frame, accepted earlier by French and Danish makers than by the English, but later to become universal (ibid: 208).

7. *Wrestplank*. The position at the back of the case in all three examples, instead of at the right side as in very early square instruments, was an invention of John Broadwood as early as 1783 (Harding 1978: 64). The light-coloured wood of Examples 2 and 3 suggests the use of beech or similar hardwood traditionally used to hold secure the wrestpins, which take the strain of the strings (Sumner 1978:77).

8. *Soundboard*. Experimentation with the position of soundboard grain was common in early nineteenth-century pianofortes (Harding 1978: 195-6). A protective covering of varnish was also common (ibid: 197). Although Example 3 is the most recent instrument, it is worthy of note that the soundboard, which has a diagonal grain placement not apparent in Examples 1 and 2, is also the one in which cracks and warping are not apparent.

9. *Bridge*. In 1783 John Broadwood had provided a grand pianoforte with two bridges (Harding 1978: 64), and in 1821 F.W. Collard utilised a second 'bridge of Reverberation' (ibid: 129-131). In each of the square instruments under discussion the bridge is divided in the treble end. The description "hollow and boxlike" used in a soundboard bridge patent of 1834 (ibid: 354) seems hardly applicable, but is interesting rather for its improbability, since the bridge must be strong enough to withstand the weight and tension of the strings.

10. *Stringing*. Sumner (1978: 76) states that in the first half of the nineteenth century there was as much experimentation with stringing as with other parts and operations of the pianoforte. Instruments were single, double, and treble strung, and Beethoven was the owner of a Viennese-made instrument with four strings to each note (ibid: 76). Multi-stringing, however, was probably best adapted to the construction of the grand pianoforte. Square instruments, according to Dolge (1972: 99), "had only two strings"; and the uniform double stringing of the present examples, with only twelve single bass strings in each instance, conforms with this statement.

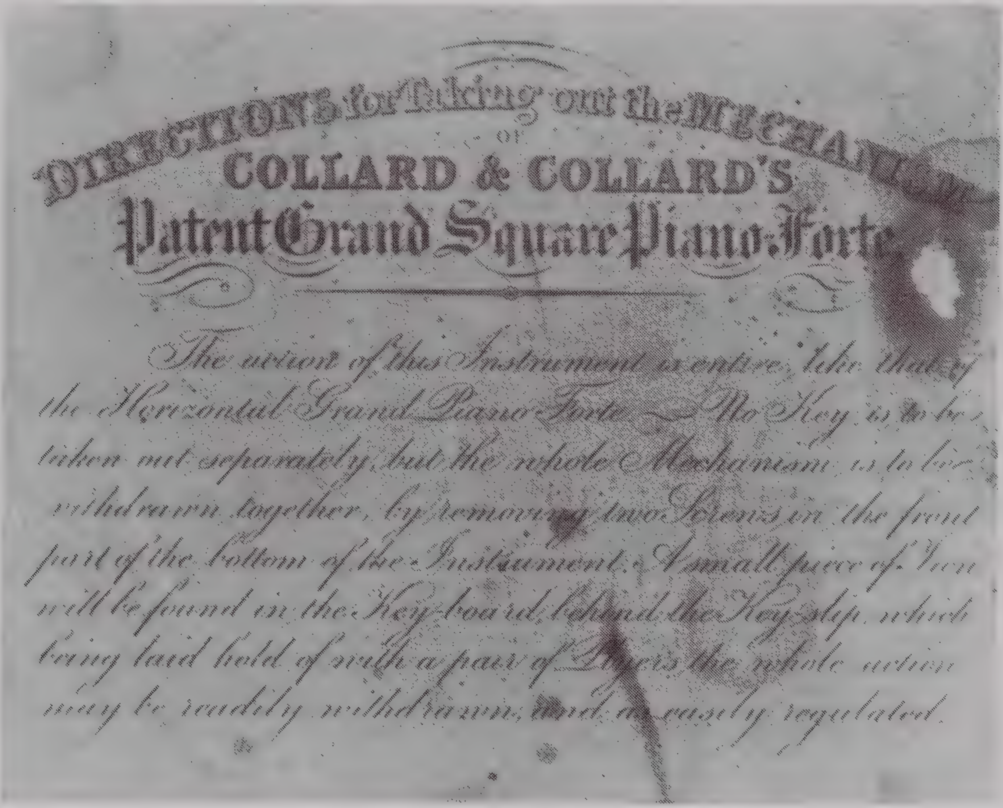
11. *Dampers*. The dampers in each instrument are attached to vertical rods activated by the pianoforte mechanism. Because of their position above the strings, they are termed in this study "overdampers", as distinct from an earlier type of underdamper also used in square pianofortes (Harding 1978: 56, 57). Experimentation in damping material is evident in the change from the loose felt pad of Example 1 to the compact layers of cloth in Examples 2 and 3.

12. *Hammers*. By today's standards the hammer heads in all three instruments are tiny, and evidence the variation in coverings which took place between the abandonment of the hard, all-leather coverings of early pianofortes and the general adoption of the all-felt covering after the middle of the nineteenth century (Dolge 1972: 97-106, Harding 1978: 179-182). In the present examples, the thin layer of leather at the centre core, covered with succeeding layers of softer materials, indicates the desire to enhance musical tone by providing a head decreasing in firmness from the wood outwards. In Example 3 the outer felt covering has become thicker. The replacement of felt for leather, or, in some cases, thick felt for thin hard felt, was, according to Pirie (1973: 33), the main cause for the great difference in tone quality between the early pianoforte and the piano of today. Increased string tension was probably the most decisive factor in the change of tone, but the development of felt as a covering for hammer heads, illustrated at an intermediary stage in the present examples, was undoubtedly of utmost significance.

13. *Manufacturers' marks and numberings*. As pointed out by Barclay (1978: 7), maker's marks and inscriptions play an important part in the identification and classifying of historic musical instruments. The incised numbers on the wrestplank in each example here are accepted as serial numbers. The possibility of the handwritten numbers immediately below them being local accession numbers has been investigated, but no evidence has been found to support this; and as they conform with published serial number categories for Collard & Collard (see Table 4), they are assumed here to be manufacturers' numbers. Pierce's reference to stencil pianos (1965: 2) suggests the possibility of the interior names T. Jobson and Winkworth of Examples 1 and 2 respectively being those of outside manufacturers. This is given some weight by the fact that the eighteenth-century firm of Longman & Broderip, later to become Clementi & Co., and still later, Collard & Collard (Grove 1980, 4: 534), was known for its policy of producing, under an "own name" contract, instruments manufactured elsewhere (Wainwright 1975: 38, Grover 1976: 90). However, the names may simply indicate the independent manufacture, either within or without the main factory, of certain component parts. That the pianoforte business was, in fact, an ideal candidate for the factory system which grew out of the Industrial Revolution, John Broadwood had already proved (Barthold & Buckton 1975: 42-43). Similarly, the numbers on the keyboard framing of Examples 1 and 2 respectively suggest piecework classification.

14. *Interior label*. Example 1 has the "Collard & Collard, late Clementi, Collard & Collard" title, as distinct from the Clementi & Co. title of its nameboard. From this the following possibilities arise: (a) that the instrument was in manufacture at the time of Clementi's death in 1832; (b) that instruments with the Clementi title were still produced by Collard & Collard after 1832; and (c) that the Collard & Collard interior label is a later addition affixed at the time of repair work. The repair work to hammers and dampers in this example seems of a rudimentary nature, but possibility (c) would allow for a pre-1832 dating. In Example 2 the subordinate "late Clementi, Collard & Collard" reference of the

nameboard label is maintained on the interior label, but in Example 3 this is dropped from the interior label (Fig.10), indicating independent progress on the part of the firm of Collard & Collard.



DIRECTIONS for taking out the MECHANISM
OF
COLLARD & COLLARD'S
Patent Grand Square Piano-Forte

The action of this Instrument is entire, like that of the Horizontal Grand Piano-Forte. No Key is to be taken out separately, but the whole Mechanism is to be withdrawn together, by removing two Screws in the front part of the bottom of the Instrument. A small piece of Iron will be found in the Key-board, behind the Key-slip, which being laid hold of with a pair of Pincers the whole action may be readily withdrawn, and as easily regulated.

Fig.10. Example 3, interior label.
Photo: Auckland Institute and Museum.

SERIAL CATEGORIZATION OF NUMBERINGS

In the available published listing of pianoforte serial numbers (Pierce 1965) some of the problems which can arise in the dating of instruments are noted (ibid: 2). The possibilities mentioned of two manufacturers being involved, and of an instrument having two different serial numbers, both have relevance to the present examples, as has been discussed in 13. above. In addition, the published categories for the firms of Clementi & Co. (ibid: 54) and Collard & Collard (ibid: 55) do not differentiate between the two firms in respect of the 1832 name-change discussed in 4. and 14. above. Grove (1980,4: 534) states that Collard & Collard serial numbers for ''squares'' continue those of Clementi; but the categories also give no indication as to whether the numbers are for ''squares'' or ''grands'', or both. In view of these anomalies, the datings set out in Table 4 must be tentative.

Table 4. Possible dates for instruments according to Pierce (1965).

Example	No.	Clementi & Co. serial category	Collard & Collard serial category
1	1580 incised	pre-1845	pre-1820
1	25302 handwritten	—	1835-40 (*c.* 1839)
2	6848 incised	pre-1845	1820-25 (*c.*1823)
2	39000 handwritten	—	1840-45 (*c.*1843)
3	9196 incised	pre-1845	1825-30 (*c.*1827)
3	45369 handwritten	—	1845-50 (*c.*1846)

CONCLUSION RE DATING OF INSTRUMENTS

The generally accepted date of 1821 as marking the first use in English pianofortes of a metal hitchpin plate, as found in the present examples (see 5. above), makes the estimated pre-1820 for Example 1 in Table 4 too early. On the basis of the change of title from Clementi & Co. to Collard & Collard in 1832, it seems reasonable, in view of the Clementi nameboard title of Example 1 and its change to Collard & Collard in Examples 2 and 3 (see 4. above), to regard 1832 as a reference point, with Example 1 preceding and Examples 2 and 3 succeeding that date. This would make the first Collard & Collard datings for Examples 2 and 3 in Table 4 also too early. In the absence of evidence to establish more precise dating, a broad grouping of the three instruments within the span of the second quarter of the nineteenth century is feasible.

THE ACTION

Because of their age and condition, it has not been thought desirable at this stage to dismantle the instruments for a complete inspection of the action mechanism. The most important improvement to pianoforte action as it had developed after the inventions of Bartolommeo Cristofori in the early eighteenth century (Clutton 1961: 88-90) related to a repetition device enabling pianists to execute the rapid repetition of notes and other techniques which their music demanded (Harding 1978: 156-7). In 1821, when the double escapement action of Sébastien Érard was patented in England, this aspect of pianoforte action was given a permanent working basis (ibid: 158). It is clear, however, that firms such as Clementi & Co. had been experimenting with their own repetition actions for a number of years. It was, in fact, John Geib, an employee of the original firm of Longman & Broderip which was taken over by Clementi in 1798 (Grove 1980,4: 483), who, as early as 1786 had taken out a patent for the "English Double Action" (Harding 1978: 56), apparently the usual action employed for square pianofortes in England (ibid: 261). The pianist Ignaz Moscheles revealed also in 1822 that in preference to other actions he used

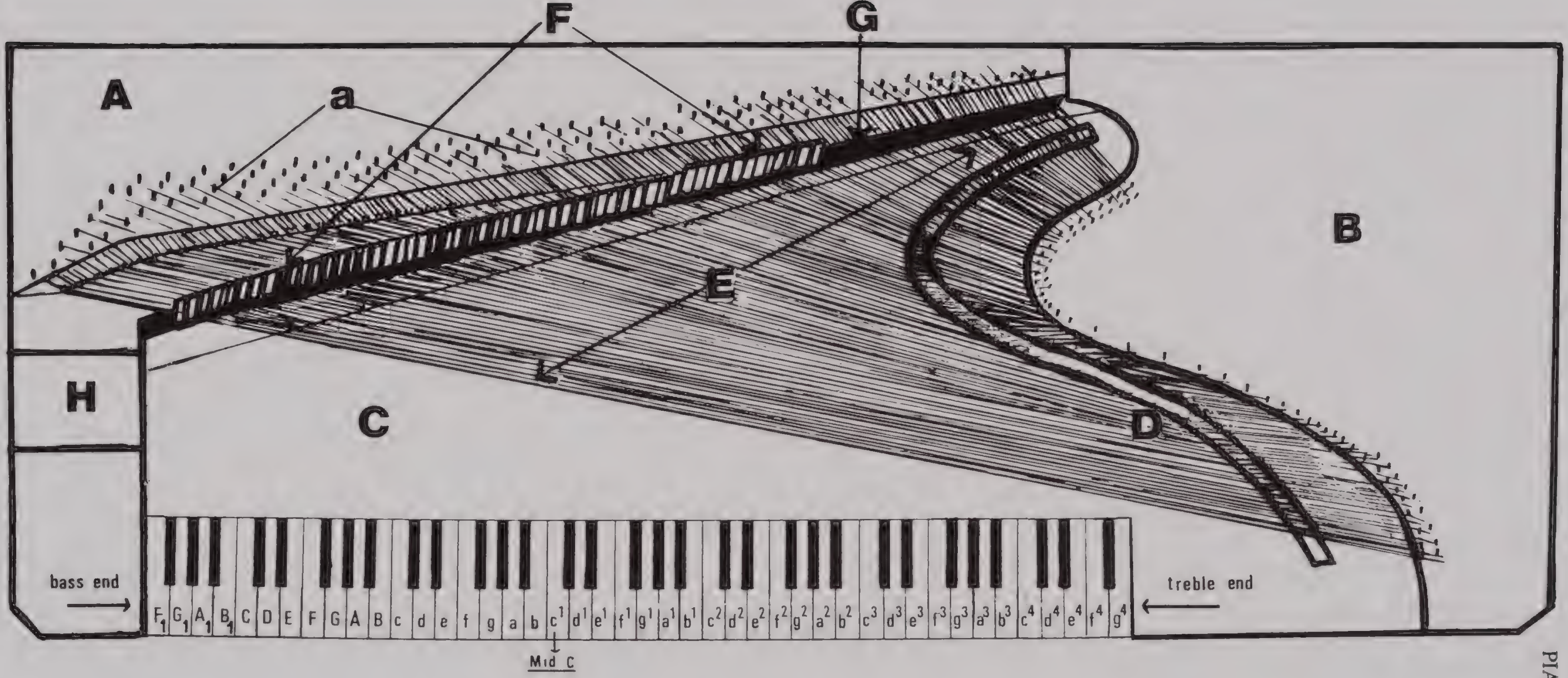
''Clementi's more supple mechanism for [his] repeating notes, skips and full chords.'' (quoted in Wainwright 1975: 71). The designation ''patent'' on the nameboard labels of each of the three instruments in the Auckland Museum, with the express designation ''Patent Repeater'' on that of Example 3 (Figs. 7-9), points to the incorporation of the firm's own repetition action. The check pad required for stabilizing and holding the hammer near the string for quick reiteration is present in all three examples.

CONCLUSION

Ehrlich (1976: 37) notes that in England during the 1850s Collard & Collard were second only to their greatest rival, John Broadwood & Sons, in annual pianoforte production. This situation suggests a continuance of the reputation enjoyed by the parent firm of Clementi & Co., whose instruments had in many countries been regarded as second only to those of Broadwood (Grover 1976: 92). Collard & Collard traditionally produced, furthermore, a higher proportion of square instruments to ''grands'' than their rivals (Barthold & Buckton 1975: 48). Closson states, too, that at the height of their popularity ''enormous numbers'' of square pianofortes were constructed in England, some even for export to oriental harems (Closson 1974: 84). Hence the phenomenon today of three nineteenth-century square pianofortes from the same English house, of uniform style and construction and all produced within a comparatively short time span of approximately twenty-five years, having found a common resting place in close proximity at the Auckland Museum.

Acknowledgements. Thanks are due to the Director and members of the Auckland Institute and Museum staff for assistance in many ways. In particular to Mr Brian Muir, Curator of Applied Arts, for help with archival information and access to the pianofortes, and for organizing their assembly and removal for photography; also to Mrs Audrey McBirney for her assistance. For arrangements in connection with the instruments' photography, I am indebted to Mr Ian Thwaites, Librarian, and to Mr Gordon Maitland, Assistant Librarian. No less are thanks due to the photographer, Mr Peter Brennan, for skill in taking the photographs. Miss Pat French and staff of the Auckland Public Library were most helpful in locating relevant material from Old Colonists' Museum records.

APPENDIX 1


F
G
A
a
B
E
H
C
D
bass end
treble end
F_1 G_1 A_1 B_1 C D E F G A B c d e f g a b c^1 d^1 e^1 f^1 g^1 a^1 b^1 c^2 d^2 e^2 f^2 g^2 a^2 b^2 c^3 d^3 e^3 f^3 g^3 a^3 b^3 c^4 d^4 e^4 f^4 g^4
Mid C

Appendix 1. Square pianoforte parts and keyboard with letter notation (compass as in Example 3).
Key: A = Wrestplank, a = Wrestpins; B = Hitchpin plate; C = Soundboard; D = Bridge; E = Strings; F = Dampers; G = Space for hammers to strike strings from below; H = Space for interior label.

APPENDIX 2

New Zealand Historical Background of Example 2

(Unless denoted by the following abbreviations details in parentheses refer to Old Colonists' Museum correspondence. Key: OCMar = Old Colonists' Museum Accession Register; AIMar = Auckland Institute and Museum Accession Register, 1958-1965; AIMc = Auckland Institute and Museum correspondence between T. Bayliss (Asst. Dir.) and Mrs T. Heywood. Jan-Feb. 1973).

In 1957 Mrs L.T. Heywood of Te Hana, Northland, wrote offering the Old Colonists' Museum in Auckland "a square grand . . . piano, made by Collard and Collard, London . . . not new when brought from Ireland by my great-grandmother in 1860 . . . " (Heywood/OCM 23/5/57). As the Old Colonists' Museum was no longer functioning in an official capacity, the offer was referred to the Auckland Public Library, who in turn consulted with the Town Clerk's office (Duthie/Town Clerk 4/6/57). The offer was finally accepted "subject to prior inspection" (Town Clerk/Duthie 12/7/57), upon the understanding that the instrument would be placed in storage. The chief librarian was then invited by the owner to inspect the pianoforte "at the old mission station that was originally the home of the Rev. William Gittos." The road was from Kaiwaka on the main northern highway, nine miles towards the Kaipara Harbour, the last mile being mostly unmetalled, so it was considered best that the inspection take place in summer weather. Furthermore, it was disclosed that the house was uninhabited "except for Maori shearers whom live there for a few weeks in December." It was therefore a matter of some concern that the piano be removed as soon as possible (Heywood/Duthie 12/8/57). The inspection duly carried out, it was eventually arranged that the pianoforte be removed to Auckland by an Auckland City Council open truck with four men (Duthie/Heywood 3/12/57). Subsequently there arrived in Auckland the second of the three examples discussed in the foregoing study (OCMar Dec 1957: 2477). Stored firstly at the Auckland Art Gallery (Duthie/Heywood 30/7/58), it was moved in 1965 to the Auckland Museum (AIMar 78/65). In 1973 correspondence concerning its whereabouts was reactivated by the former owner, who recalled at that time that the keyboard had "middle C very worn" (AIMc Heywood/Bayliss 9/2/73), a remark which conforms with the state of the keys of Example 2 (see Table 2, keyboard). A further reference to the interior as "solid brass" (ibid) was probably an impression received from the surface expanse of the brass plate (see Table 2, hitchpin plate), which is a dominant feature upon opening the lid of the instrument.

To summarise, a London-made pianoforte travels firstly to Ireland, from whence it is transported (*c*.1860) by sailing-ship to antipodean New Zealand. A brief note amongst Old Colonists' Museum correspondence: "came by sea to Mangawhai and then by bullock dray to Kaiwaka" (Heywood n.d.) gives hint of further vicissitudes.

No doubt a long period of use in the domestic environment of a pioneer New Zealand family followed, but exposure to neglect and the activities of shearing gangs was still to follow. A journey to Auckland in an open truck nearly one hundred years after its arrival in New Zealand, and a subsequent transfer to a new storage location, complete the journeying of this antique instrument. It is not surprising that Example 2 is the shabbiest in appearance of the three instruments under discussion. If the wear and tear of its various removals is apparent on the exterior, however, internally Example 2 still compares favourably with Examples 1 and 3.

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NEW AND INTERESTING RECORDS OF ADVENTIVE PLANTS FROM THE AUCKLAND INSTITUTE AND MUSEUM HERBARIUM 9

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Abstract. This ninth list of some recent additions to the Auckland Institute and Museum Herbarium (AK) and re-determinations of earlier gatherings provides new records for some adventive species and further information on the distribution of others.

The main source of material for this ninth list has been by exchange with D.S.I.R., Botany Division, Christchurch (CHR) and the National Museum, Wellington (WELT). In addition, specimens have been presented by Mr A.E. Esler, D.S.I.R., Auckland and Mr J. Mackinder, who has deposited voucher specimens in connection with the Waitakere Adventive Project. Mr A.E. Wright, Botanist at this Museum, has prepared for incorporation much material gathered during several field excursions.

The nomenclature adopted in this paper is that published by the New Zealand Weed and Pest Control Society (1969) except for species dealt with in volume 3 of the *Flora of New Zealand* (Healy & Edgar 1980) and in the series of checklists published in the *New Zealand Journal of Botany* from 1978 onwards by members of the D.S.I.R., Botany Division staff at Christchurch.

All specimens are cited by the AK number and, where these are provided, by the collectors' numbers. Unless otherwise stated the specimens may be regarded as the only material of the species possessed by the Herbarium and, where no previous literature is cited, as first records to the best of my knowledge at the time of writing.

RANUNCULACEAE

Aquilegia vulgaris L.

Waitemata Co., Waitakere Range, dam access road, Waitakere Reservoir, 1981, J. Mackinder, AK 157947.

Information on the history of the columbine may be found in Bangerter (1980) and its distribution in Garnock-Jones (1981). This second gathering in the AK Herbarium is the most northerly.

Rec. Auckland Inst. Mus. 20: 165-174 23 December 1983

CRUCIFERAE

Barbarea intermedia Bor.

Christchurch, waste places in vegetable plot, 1963, B.H. Macmillan 63/37, AK 150707, (dupl. ex CHR 140924).

Two localities are cited in Bangerter (1976) for this wintercress, both in the North Island. The specimen above adds a representative from the South Island. Noted on the label is "first noticed in this locality Oct. 1961, now plentiful." Distribution according to Garnock-Jones (1979) is "throughout (including Stewart I.)." Esler (1978) in recording it for the Manawatu area states "nowhere abundant or troublesome."

Brassica fruticulosa Cyr. ssp. *mauritanica* (Cosson) Maire

Wellington, waste land outside Wellington Airport, 1977, A.E. Wright 2502, AK 142948; Wellington, Abel Smith Street, waste ground, 1979, P.J. Brownsey, AK 149974, (dupl. ex WELT). Both det. P.J. Garnock-Jones.

As stated by Garnock-Jones (1979), the first record for this *Brassica* is in Healy (1957) as *B. integrifolia,* the locality being "sand-dunes near Paraparaumu."

Lepidium sativum L.

Auckland City, Symonds Street, 1980, E.K. Cameron E6, AK 156412, det. Botany Division (CHR), (dupl. ex AKU 10224).

A note with this duplicate from the Auckland University Herbarium states "bare open area, white flowers and strong white tap-root 16cm long, plant 8cm tall, glaucous". This cress was first recorded by Hooker (1864), then by Thomson (1922) and Allan (1940) and listed by a few other authors. Garnock-Jones (1979) recorded it as still rare and local.

Lunaria annua L. ssp. *annua*

Waitemata Co., Waitakere Range, Waiatarua, Scenic Drive, 1981, J. Mackinder, AK 157938-9.

Honesty was first recorded by Allan (1940) who, according to Garnock-Jones (1979), gave its distribution as Palmerston North southward to Stewart Island. The above specimen "growing amongst weeds and rubbish" was presented by the collector. As *L. annua* var. *albiflora* is not considered distinct by Garnock-Jones, the record for this variety in Healy (1958) from Ashburton is attributed to the type subspecies. Matthews (1975) gave "weed of waste areas" as a habitat.

RESEDACEAE

Reseda lutea L.

Waikato Co., Pukeroro, J.D.P. Morgan, AK 72051.

The first record for cut-leaved mignonette was published by Cheeseman (1906) as stated by Garnock-Jones (1979). The above gathering, although undated, serves as a voucher as Cheeseman cites "fields at Pukeroro" for the locality. Cheeseman (1914) also recorded a specimen collected by F. Neve from "slopes of Mt Eden, Auckland". A record of a collection by Petrie, Central Otago, 1892, was apparently first published by Thomson (1922).

CRASSULACEAE

Cotyledon orbiculata L.

Waitemata Co., Anawhata, growing on cliffs between Piha and Anawhata Beach, 1980, J. mackinder, AK 154858.

This second gathering, from a much more northerly locality, adds to that recorded by Bangerter (1981).

CUCURBITACEAE

Citrullus lanatus (Thunb.) Matsum. & Nakai

Waitemata Co., Anawhata, growing on cliffs between Piha and Anawhata Beach, 1980, J. Mackinder, AK 154858.

Kirk (1870) and Cheeseman (1883) early recorded the watermelon as a naturalised plant. Thomson (1922) and Allan (1940) repeated these records and Sykes (1982) gave the known recent distribution as "Escape from cultivation; northern North I., rarely elsewhere."

MALVACEAE

Lavatera trimestris L.

Waimea Co., Nelson, waste ground on reclamation at base of causeway to Boulder Bank, 1979, A.E. Wright 3238, AK 151479.

The first record for this species was published in Webb (1981), where Nelson is included in the distribution. Other material in the AK Herbarium consists of garden specimens.

EUPHORBIACEAE

Euphorbia nutans Lag.

Streets of Auckland, T.F. Cheeseman, AK 74945, as *E. hypericifolia;* Auckland, 500m south of Greenlane station, 1982, A.E. Wright 4838, AK 159254, det. C.J. Webb.

Nodding spurge was recorded by Cheeseman (1883) for the Auckland area as *E. hypericifolia,* a voucher specimen for which was wrongly attributed to *E. maculata* in

Bangerter (1978). The more recent gathering above has "growing in gravel between railway lines" as a habitat. For further information on this species Webb (1981) should be consulted.

PAPILIONOIDEAE

Vicia villosa Roth. ssp. *varia* (Host) Corb.

North Canterbury, near Spye, roadside bank, 1979, W.R. Sykes, AK 151609, det. C.J. Webb (dupl. ex CHR 362849); North Canterbury, c.2km south of Greta Valley, roadside bank, 1980, C.J. Webb NIT 113, AK 151610 (dupl. ex CHR 362847).

The specimens above have been sent as duplicates from Christchurch and are vouchers for the localities cited in Webb (1980). Fodder vetch was first recorded by Healy (1957) from Tauwharenikau, Wairarapa, 1953. Flower colour noted for the first above is "corolla blue-violet" and for the second "purplish-blue."

UMBELLIFERAE

Oenanthe aquatica (L.) Poir.

Marlborough, Tua Marina, at Centennial Cairn, 1980, C.J. Webb NIT 109, AK 151622, (dupl. ex CHR 327371).

Horsebane was first recorded by Allan (1940) from the Marlborough area. It has not extended its distribution according to Webb (1978). With the above specimen, acquired by exchange from DSIR Christchurch, is a note "flowers white; quite common and well established in this area."

Torilis japonica (Houtt.) DC.

Rangitikei Co., Moawhango, Taihape Loop Road, 1968, P. Hynes, AK 117856; North Canterbury, near coast north of Hundalee Hills, roadside bank, 1980, C.J. Webb NIT 112, AK 151621, (dupl. ex CHR 362827).

The habitat for the first specimen above is given as "bush remnant" and a note with the second, acquired also by exchange from Christchurch, states "well established; flowers white, tinged pink". Webb (1978) gave the distribution of upright hedge-parsley as southward from South Auckland. The first published record is in Healy (1957) where a number of scattered localities were given.

Torilis nodosa (L.) Faertn.

Auckland, One Tree Hill, Cornwall Park, 1977, A.E. Wright 1823, AK 141873; Banks Peninsula, Prices Valley, 1980, C.J. Webb 80/3, AK 151616, (dupl. ex CHR 327369).

Information on the distribution and recording of hedgehog-parsley is in Webb (1978). The above Auckland specimen was collected from "cracks of pavement beside rock wall'' and the other from ''pasture on hillside and under trees''. It was first recorded long ago from Great Barrier Island by Kirk (1869).

COMPOSITAE

Senecio cineraria L.

Nelson City, western end of Tahunanui Beach, 1979, A.E. Wright 3181, AK 151438.

In the appendix to his book Allan (1940) mentioned dusty miller without giving localities but Healy (1959) recorded the plant for coastal cliffs between Redcliffs and Sumner, Canterbury. The latter author referred again to that habitat in his account of Canterbury adventives (Healy 1969). A note with the gathering above states ''naturalised among sand dunes behind beach; flowers just beginning.''

Senecio cruentus DC.

Auckland City, St. Heliers, abundantly naturalised on sea cliffs at Achilles Point, 1982, A.E. Wright 5172, AK 159830.

Records for garden cineraria as a horticultural escape seem to be few. Esler (1980) listed it for Motutapu ''under pohutukawa tree'' and Molloy (1980) for Gore Bay and Port Robinson.

SOLANACEAE

Cyphomandra betacea Sendt.

Kermadec Islands, Raoul Island, growing wild in forest margins about Matatirohia, 1956, R.C. Cooper, AK 44382; Tokomapuna Island (east of Kapiti Island), 1982, A.E. Wright 4785, AK 159503.

Most of the literature I have traced deals with potential diseases of the tamarillo rather than its distribution as an escape from cultivation. The habitat note for the second record above is ''one plant 1m high growing beneath taupata canopy.''

Solanum sublobatum Roem. & Schult.

Ashburton Co., Canterbury, Upper Rakaia Gorge, 1964, P. Hynes, AK 150992.

Mrs. Hynes' specimen of velvety nightshade, recently presented, is the third added to the two recorded in Bangerter (1980) and the first in the AK Herbarium from the South Island. Sykes (1981b) gave further information and stated the first record to be in Baylis (1958).

ACANTHACEAE

Acanthus mollis L.

Waitemata Co., Milford, Wairau Creek estuary, 1980, E.B. Bangerter 5491, AK 152486.

This gathering has been added to the one cited in Bangerter (1980), where some history of the species may be found. Further information was given by Sykes (1981a). Esler (1978), recording the plant for the Manawatu area, stated "not a weed of importance at present."

LABIATAE

Origanum vulgare L.

Lake Co., Queenstown, Skippers Road near Skippers, 1982, A.E. Wright 4817, AK 159013.

Marjoram was first recorded by Healy (1944) as stated by Sykes (1978). It was also listed by Healy (1969) for Canterbury. So far its distribution is limited to the South Island. A habitat note with the above gathering says "growing amongst loose rock at side of track down to the Shotover River."

LILIACEAE

Allium roseum L. ssp. *bulbiferum* (DC.) E.F. Warb.

Waitemata Co., Waitakere Range, Titirangi, Scenic Drive, 1981, J. Mackinder, AK 157946.

This specimen, the second in the AK Herbarium, has "roadside above dumped rubbish" on the label. The first was cited in Bangerter (1976). Further information, including a description, is in Healy & Edgar (1980).

Muscari armeniacum Baker

Waitemata Co., Waitakere Range, Ahuahu Road, 1978, J. Mackinder, AK 154463; Wellington, Karori Cemetery, naturalised on grassy bank, 1978, N.M. Adams, AK 145119, (dupl. ex WELT).

A detailed description of the grape hyacinth was given in Healy & Edgar (1980). The only specimen hitherto in the AK Herbarium was cited in Bangerter (1980). The first gathering above was presented by J. Mackinder and the second was acquired by exchange with the National Museum's Herbarium in Wellington. Adams (1980) provided an illustration.

Nothoscordum inodorum (Ait.) Nichols.

Auckland, Newmarket, north end of Olympic Pool, 1980, A.E. Wright 3624, AK 152029.

In Bangerter (1980) it was stated that the first certain record for this plant was from Whakatane, 1914; unfortunately the date is incorrect and should be 1944. A description and history of the species are in Healy & Edgar (1980). A note with the above specimen reads ''abundant weed in gardens, pavement cracks etc.''

Scilla non-scripta (L.) Hoffm. & Link.

Hokianga Co., Waipoua State Forest, Kawerua, around hut, 1976, A.E. Wright 1391, AK 141142; Wellington, South Karori Road, 1978, P.J. Brownsey, AK 149151 (dupl. ex. WELT); Waitemata Co., Waitakere Range, Ruaotewhenua, Scenic Drive, 1981, J. Mackinder, AK 157944.

The first record for the bluebell, in Healy (1958), does not include any localities as far north as Hokianga; Healy & Edgar (1980) gave Auckland City as the most northerly. Adams (1980) provided an illustration. Dr Brownsey's specimen was gathered from a stream bank whereas Mr Mackinder's was from ''roadside growing amongst horticultural discards.''

Tulbaghia violacea Harv.

Waitemata Co., Forest Hill, edge of bush reserve, 1980, E.B. Bangerter 5463, AK 151555.

Bangerter (1976) first recorded this plant as acknowledged in Healy & Edgar (1980). The gathering above has a note ''few plants among a colony of *Crocosmia* x *crocosmiifolia* with scattered *Ulex europaeus*.''

AMARYLLIDACEAE

Leucojum aestivum L.

Hokianga Co., Waipoua State Forest, growing around hut at Kawerua, 1976, A.E. Wright 1390, AK 141144.

This locality is more northerly than those given in Healy & Edgar (1980) and the gathering has been added to the two recorded in Bangerter (1975).

Narcissus bulbocodium L.

Waitemata Co., Waitakere Range, Titirangi, Scenic Drive, 1981, J. Mackinder, AK 157945.

Healy & Edgar (1980) reported that this daffodil ''had been once collected at Pomare, Hutt Valley, in a roadside ditch ...... 1971.'' The above specimen from ''roadside above dumped rubbish'' adds a locality much further north.

Narcissus tazetta L. agg.

Waitemata Co., Milford, Wairau Creek estuary, 1981, E.B. Bangerter 5521, AK 155134; Waitemata Co., Waitakere Range, Destruction Gully, 1981, J. Mackinder, AK 157940.

The first record for this narcissus was published by Healy (1958) as noted by Healy & Edgar (1980), where a description and distribution are given. The first gathering above has a note "in waste area with other adventive weeds. Petal lobes white, corona yellow." The second, listed by Mackinder (1982), has "well established in roughly cleared area."

IRIDACEAE

Ixia maculata L.

Waitemata Co., Waitakere Range, Titerangi, Scenic Drive, 1981, J. Mackinder, AK 157956.

The first record for this species was published by Healy & Edgar (1980), the first collection being from Hutt Valley in 1953. The specimen above was collected from a "roadside."

JUNCACEAE

Juncus continuus L. Johnson

Auckland City, Grafton Gully, 1981, R.O. Gardner 2907, AK 153675, det. E. Edgar.

The sole record for this rush in Healy & Edgar (1980) is from Lake Rotokawau, Mangonui Co. Dr Gardner's habitat note reads "one unhealthy clump in muddy weed-infested area by stream."

GRAMINEAE

Poa palustris L.

Marlborough, para swamp near Koromiko, 1947, A.J. Healy H234, AK 150686, det. V.D. Zotov, (dupl. ex CHR 54535).

This grass was first recorded by Healy (1944) from Moutoa swamp, a locality to which reference is made in Esler (1978).

Sorghum halepense (L.) Pers.

Auckland, Remuera, alleyway between Kelvin and Pukeora Roads, 1980, A.E. Wright 3644, AK 152483; Auckland, Parnell, The Strand, between 'bus park and railway marshalling yard, 1981, A.E. Wright 3825, AK 156466.

When recording the first specimen in the AK Herbarium, Bangerter (1980) gave some information on the spread of Johnson-grass. These two additions indicate its spread further north. Accompanying notes with the Parnell plant state "3 x 2m patch on rich soil. Spreading by means of 5-6mm thick underground rhizomes" and with the Remuera plant "discrete patch 2m long at foot of hedge." Both the above colonies were subsequently eradicated by the Ministry of Agriculture and Fisheries.

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CONSERVATION STATUS OF THE THREE KINGS ISLANDS ENDEMIC FLORA IN 1982

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Abstract. Despite the classification of many of the Three Kings Islands' endemic plants as threatened species, they were last surveyed by botanists in 1963. The most recently published detailed information on their distribution and population size appeared in 1951. The present survey was carried out to provide a current report on the conservation status of the endemic flora of the islands, on which vegetation management decisions could be based. In 1982, all the endemic taxa were found to be present in equal or greater numbers of individuals than have been found in the past. Management strategies are briefly discussed.

An Offshore Islands Research Group expedition to the Three Kings Islands from 12 to 18 December 1982 afforded the first opportunity for a review of the conservation status of the locally endemic plant flora in over 30 years.

A sizeable population of goats on the largest island, Great Island, had seriously depleted the vegetation and effectively halted regeneration of palatable species by the time they were exterminated in 1946. By this time, two of the endemic species had been reduced to single individuals, and several others to extremely small populations surviving in degraded and marginal habitats.

Following removal of the goats, regeneration of the plant cover proceeded rapidly. This regeneration has been discussed by Baylis (1948, 1951b, 1958) and Turbott (1963), and specifically studied by Holdsworth (1951) and Holdsworth & Baylis (1967) through a series of three permanent vegetation quadrats set up immediately following the extermination of the goats (Turbott 1948).

However, the vascular flora of the Three Kings Islands was last studied by botanists in 1963 as a corollary to work on the vegetation quadrats (Holdsworth & Baylis 1967) and on a short visit made by Mr Ross Michie and others (Michie 1963). Despite these reports the most recent account of the conservation status of the endemic plants appeared over 30 years ago (Bayliss 1951b). Although dramatic regrowth of the vegetation was reported at that time, some of the endemic species had failed to reproduce in substantial numbers. Consequently, fears had been expressed for the survival of some species in the wild during the intervening period to the present.

Thus, the 1982 expedition offered Professor G.T.S. Baylis and myself an opportunity to re-survey the distribution, and population size and structure of the endemic plants, and recommend a suitable management policy for the islands' vegetation. Five days were spent on Great Island and brief landings were made on West and South West Islands.

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ENDEMIC FLORA

In the past, thirteen taxa of vascular plants have been considered to be endemic to the Three Kings Group (Baylis 1958, Allan 1961, Moore & Edgar 1970), and a fourteenth was known only from one small island elsewhere (Baylis 1963). One of these plants *(Cordyline kaspar)* and possibly a second *(Alectryon grandis)* have subsequently been recognised on the Poor Knights Islands (Wright in prep.). A third, *Coprosma macrocarpa*, was interpreted by Allan (1961) as having a distribution beyond the Three Kings, though there is no doubt that Cheeseman (1888) erected the species solely for the large-fruited Three Kings plants. *Solanum aviculare* var. *latifolium* was based on Three Kings material, although it has also been recorded from Fanal Island in theMokohinau Group (Baylis 1963). Regardless of actual or possible wider distributions, all these taxa will be considered together with the undoubted endemic plants in this paper.

Alectryon grandis Cheeseman

In 1945 (Baylis 1948), two trees of the Three Kings' titoki were mapped, one at each of localities 1 and 2 on Fig. 1. Baylis (1951b) found no seedlings near either of these trees but added a further two trees and plentiful seedlings over *ca.* "50 yards" [45.7 m] along the bottom of a small gully on the northern side of the northern headland of Tasman Bay (Fig. 1, locality 3), which were overlooked in the preparation of the 1945 map. Michie (1963) found the tree at locality 2, erroneously recording that this was "the only place where a few trees had been previously discovered". Despite searching, we failed to find either of the trees at localities 1 or 2 in 1982. However, the population at locality 3 had expanded considerably by 1982. It was established on rocky ground in the head of a slight but steep gully above the coastal cliffs. Seventeen mature trees (several up to 12 cm diameter at breast height (d.b.h.) and 6-7 m tall), 13 saplings and 22 seedlings were counted over an area approximately 80 x 15 m. The titoki had spread into the neighbouring small gully to the south. Here, a further seven mature trees and four saplings were found. Several of the mature trees were flowering heavily, and abundant remains of seeds were found beneath them.

Brachyglottis arborescens W.R.B. Oliver

Baylis (1948, 1951b) recorded the presence of two moribund groves of the Three Kings' rangiora surrounded by "thickets of seedlings up to 6 feet" [1.8 m] high, at localities 4 and 5 (Fig. 1). He found occasional seedlings further from these sources, noting however that the species had not yet entered Tasman Valley. His 1948 list recorded the plant as rare, with 35 individuals in existence.

By 1963, this species was present in Quadrats I and II (Fig. 1, locality 6), although it contributed a relatively small basal area to the plots (Holdsworth & Baylis 1967: 183). Michie (1963) noted that the rangiora was "fairly well distributed over the island". By 1982 it was locally abundant in many areas. It apparently favours the rich soils associated with sea-bird burrowing and appears to attain maturity very quickly in these situations. Many older trees were showing signs of senescence; canopy gaps resulting from the few dead trees observed were being filled by numerous seedlings and saplings of the same species. As these dead trees were found in areas which have been colonised by the species

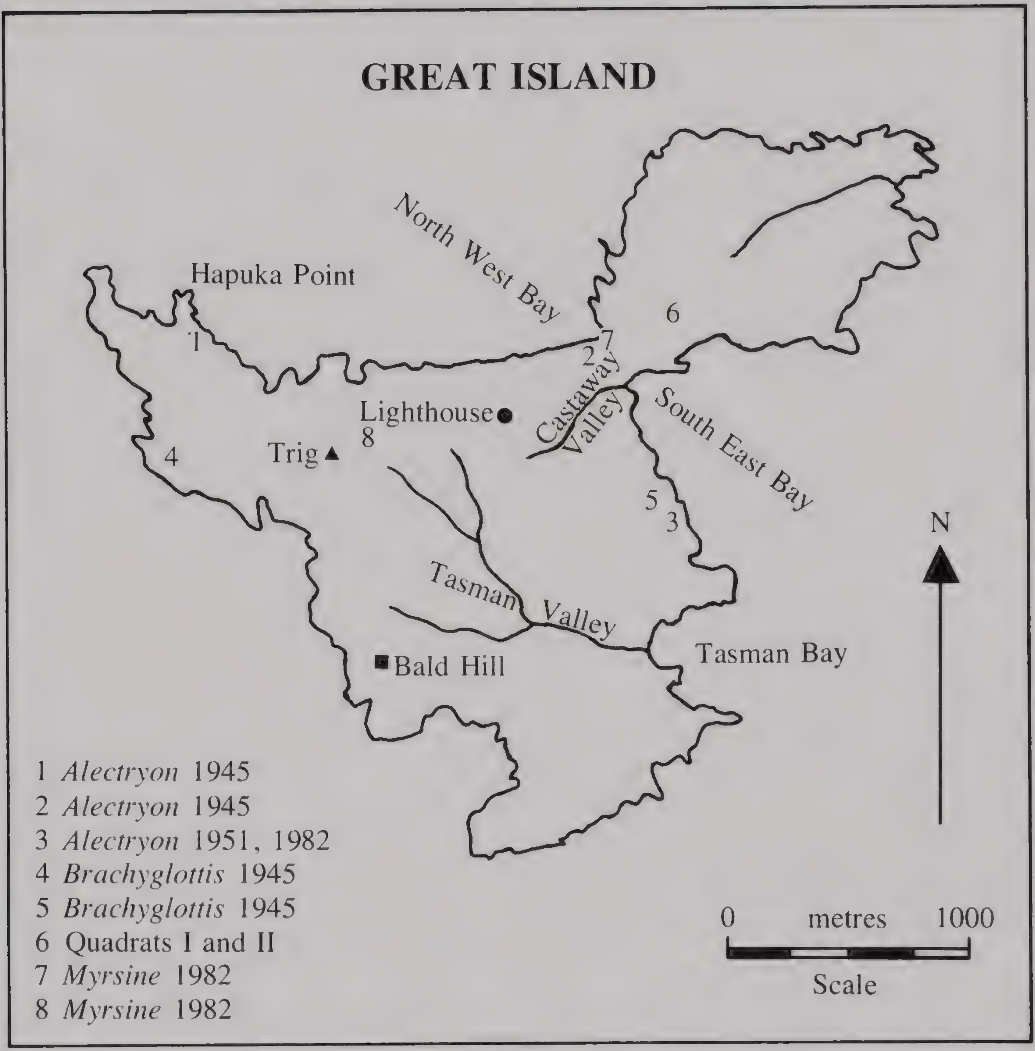

Fig. 1. Map of Great Island, Three Kings Islands, showing localities mentioned in the text.

since the removal of goats, the rangiora is apparently to some extent a short-lived, opportunistic element of the Three Kings' flora. One of Baylis's original groves was relocated (Fig. 1, locality 5). Here, slower growing trees in the rocky soils at this site had developed trunks to 30 cm in diameter, with their characteristic deeply furrowed bark.

Carex elingamita Hamlin

This species was described byHamlin in 1958. Previously it had been considered a part of *C. forsteri* Wahl. (Baylis 1948, Oliver 1948), and had therefore attracted no special mention. Baylis (1958) described the species on South West Island, where it provided a ground cover "dotted at intervals" along the forest floor, and Hamlin (1958:

393) listed specimens from each of the four main islands in the group. Michie (1963) noted the existence of an endemic species of *Carex*, but made no reference to having seen it on Great Island.

Carex elingamita was found to be a common ground cover plant beneath forest canopy on both West and South West Islands in 1982. However, on Great Island it was infrequently seen. Here, *Carex testacea* replaces *C. elingamita* as the dominant ground cover sedge. The thinner leaved, generally tougher *C. testacea* may have withstood browsing by goats more successfully than the wider leaved *C. elingamita* which is now more or less confined to the regenerating stands of broadleaved forest (*Meryta sinclairii* (Hook. f.) Seem., *Brachyglottis arborescens*, *Streblus smithii* (Cheesem.) Corner and *Pisonia brunoniana* Endl.) — that is, a similar habitat to that in which it is found on West and South West Islands. *Carex testacea* forms dense swards beneath the relatively open kanuka (*Leptospermum ericoides* A. Rich.) canopy in the head of Tasman Valley, where it has every appearance of a browsing-induced dominant. When (and if) this community is replaced by the denser canopied broadleaved species, *C. testacea* may be shaded out and replaced by *C. elingamita*.

Coprosma macrocarpa Cheeseman

Following the extermination of goats in 1946, protracted searching led to the discovery of four individuals of this species (Baylis 1948), despite the fact that Cheeseman (1888) had recorded the plant as common. By 1951, young plants were common in the bottom of Tasman Valley, and a few seedlings had reached Castaway Valley (Baylis 1951b). Michie (1963) recorded the species as "well distributed", although in the same year, Holdsworth & Baylis (1967) did not record it in either of Quadrats I or II. By 1982 it was truly well distributed over the island, being encountered in all areas explored. Despite the inclusion of mainland forms under this name by later workers (e.g. Allan 1961), it is clear that Cheeseman (1888), when describing the species, saw fruit size as the major distinction between the Three Kings plants and related forms. He gave the average length of fruit "as about three-quarters of an inch" [19 mm], and observed some specimens "over one inch" [26 mm]. Although no fruit of comparable size was seen in 1982, all berries were at least twice the size of those of any of the northern mainland taxa of this genus.

Cordyline kaspar W.R.B. Oliver

This species (listed as *C. australis* prior to its description by Oliver 1956) has always been recorded as common on Great Island. Baylis (1951b) stated that "cabbage trees were well dispersed over the island in 1945 and were flowering abundantly". In 1982, the Three Kings cabbage tree was found to be a visually dominant part of almost all plant communities on Great Island.

Davallia tasmanii H.C. Field

This fern was discovered by Cheeseman on Great Island in 1887 and initially described without name (Cheeseman 1888). Following his second visit to the islands in 1889, Cheeseman prepared a further paper which included a description and name for the *Davallia* which was read before the Auckland Institute on 3 November 1890. However, it was not published until 1891 (Cheeseman 1891). Meanwhile, H.C. Field had published the name in his *Ferns of New Zealand* (Field 1890), thereby technically becoming the author of the name *Davallia tasmanii*.

This is another of the endemic species which seems to have withstood the depredations of goats fairly well. It can grow in rock crevices and on the lower parts of tree trunks, and now often forms extensive colonies on the open floor of kanuka forestm

Elingamita johnsonii G.T.S. Baylis

This species, endemic to West Island in the Three Kings Group, was discovered by Major Johnson in January 1950. He returned to the island with Professor Baylis in the following year, and Baylis subsequently (1951a) formally described the new species. Baylis's observations were made in dense fog, in which the full extent of the population could not be seen. He recorded "perhaps a dozen trees" on West Island. No landings had been reported subsequently until our party went ashore for several hours on 17 December 1982. We were fortunate to experience clear, sunny weather in which the *Elingamita* could be photographed *in situ* for the first time, and a clear description of the plant's habit and distribution made.

The first plant was found in low scrub composed mainly of N.Z. flax (*Phormium tenax* J.R. et G. Forst.) with small amounts of houpara (*Pseudopanax lessonii* (D.C.) C. Koch), kawakawa (*Macropiper excelsum* (Forst.f.) Miq. var. *majus* (Cheesem.) Allan) and *Hymenanthera novae-zelandiae* (A. Cunn.) Hemsl. just above the site of the wreck of the *S.S. Elingamite*. This plant bore panicles of open flowers, bunches of unripe green fruit and the remnants of bunches of ripe red fruit, indicating the probability of a two year cycle from flowering to fruit maturity.

A scattering of shrubby small trees and saplings was found at the base of the irregular row of rocky bluffs along the southern face of the island. The major population containing the oldest trees was found in a small area of pohutukawa (*Metrosideros excelsa* Sol. ex Gaertn.) forest near the summit of the island. The pohutukawas provided a semi-continuous canopy some 10-12 m high, beneath which *Elingamita* formed an understorey 2-4 m high. A dozen trees were sighted from one point in this area of forest, each bearing hanging bunches of ripe scarlet fruit. Numerous seedlings were found in the rich, light humus between the rocks — there were nine growing in one area three centimetres square. The seedlings exhibit the same conspicuously thickened, fleshy looking stems as the adults.

Despite their obvious attractiveness, there was no evidence of birds having eaten the ripe fruit. Although seedlings have been dispersed over several hundred metres from this main colony, they are most common beneath fruiting trees, and have not reached other apparently suitable habitats in developing forest on the main ridge of the island. It is presumably only a matter of time before the species is naturally introduced or reintroduced to other islands in the Three Kings Group.

Hebe insularis (Cheeseman) Cockayne et Allan

Northern species of *Hebe* are usually highly palatable to goats and the Three Kings' endemic is apparently no exception. By 1946 (Baylis 1948) it was restricted to sites inaccessible to goats, mainly on the sea cliffs. Baylis (1951) recorded its appearance on Bald Hill — the first woody species to occupy this most barren part of the Three Kings' landscape. In 1982 it was still predominantly a plant of cliffs, and had increased its range on Bald Hill where compact shrubs were the locally dominant vegetation, dotted over an area of still partially bare ground several hundreds of metres square. Its present distribution reflects the habitat requirements of a low growing, light demanding shrub rather than any failure to spread following the extermination of goats. The species is now frequently met in coastal situations that would have been accessible to goats.

Myrsine oliveri Allan

In 1945, Baylis (1948) saw seven individuals of this species, some located near the present Trig station on the highest point of Great Island (Fig. 1) and some with one of the original *Alectryon* trees, (Fig 1, locality 1). Oliver (1948: 231) gave a slightly different distribution for the seven plants. In 1951, Baylis (1951b: 106) noted that no seedlings were seen beside any of the existing trees of this species. Fruiting had only been observed on two trees, both at Hapuka Point (Fig 1, locality 1), one of which died between 1945 and 1951. Baylis (1951b) also recorded a few seedlings which seemed to be of this species about the campsite in Castaway Valley. That he was unsure of the identity of the seedlings is no doubt due to the close similarity between young vegetative material of this species and of *Hymenanthera novae-zelandiae*.

By 1982 the population of *Myrsine oliveri* appeared to be bigger than in 1951. The present stronghold for the species is the area supporting the *Alectryon* colony (Fig. 1, locality 3). Here, two distinct forms occurred: two young saplings in an exposed situation on a grassy ridge exhibiting thickened yellowish leaves, and six mature trees beneath adjacent kanuka canopy with glossy, dark green leaves. These last bore a sparse crop of fruit, the largest tree being 4 m high, having a spread of 2.5-3 m and a split trunk of 8 + 4 cm d.b.h. Both exposed and shaded plants were healthy and growing vigorously, but no seedlings were located. A further six plants to 2 m tall were found amongst the regenerating coastal forest in the lighthouse clearing (Fig. 1), and single young shrubs were found on the ridge between North West and South East Bays (Fig. 1, locality 7), and at the clifftops near the Trig (Fig. 1, locality 8). Again, no seedlings were seen at any of these localities.

Pennantia baylisiana (W.R.B. Oliver) G.T.S. Baylis

The sole wild tree of this species has not produced any seedlings. Of the two cuttings planted adjacent to the parent tree by Professor Baylis in 1971, one survives and has doubled in size. The tree has grown considerably since its discovery, and was looking very vigorous and healthy. The foliage appeared to be far less insect damaged than past photographs and herbarium specimens indicate. The surrounding habitat, shown by Oliver

(1948: pl. 32) as bare rock scree, has regenerated almost beyond recognition with a thick cover of ferns and herbs, and the base of the *Pennantia* is now obscured by a dense growth of its own shoots.

The tree was profusely covered in bunches of small ovaries, approximately 1 x 1.5 mm, and probably unfertilised. The status of occasional larger "fruit" scattered through these bunches is uncertain, and should be investigated with a view to encouraging production of viable seed.

Pittosporum fairchildii Cheeseman

From the four plants known at the time of the extermination of goats (Baylis 1948), a healthy and widespread population has developed. By 1951 seedlings were spreading from the parent trees, and in 1963 Michie recorded the species as fairly common in the western part of the island.

In 1982 plants were occasionally encountered over most of the island. The greatest concentrations of the species occur in rocky areas near Quadrats I and II, and beneath tall, sparse kanuka forest in the head of Tasman Valley. In Tasman Valley, particularly in the headwaters of the true right branch of the stream, the plant is abundant. It ranges from seedlings to 3 m high trees of 5-6 cm d.b.h., both beneath and occasionally thrusting through the kanuka canopy. Many of the trees bore a heavy crop of almost ripe yellow fruit in November 1982.

Solanum aviculare Forst. f. var. *latifolium* G.T.S. Baylis

This taxon was noted by Cheeseman (1889) as *S. aviculare*, and was apparently extinct on Great Island at the time of the goat extermination. The first find this century was made in 1947 (Baylis 1948, appendix). Baylis (1951b) characterised the plant as an "aggressive temporary occupant" of disturbed sites, and this holds true today. In 1982 it was found on both Great and South West Islands in soils disturbed by sea-bird burrows (amongst the coastal margins of vascular plant vegetation and on inland ridges), and in areas opened up by the death of mature trees. One 60 cm high juvenile on South West Island exhibited leaves over 50 cm long with four or five pairs of lateral lobes. Although the plant was never seen in great numbers, it fruits freely and seeds germinate readily in suitable habitats. It is a long term "weed" species in the Three Kings' flora.

Streblus smithii (Cheeseman) Corner

The Three Kings' milk tree survived the onslaught of goats better than any of the other dicotyledonous endemics, being classed as "occasional" by Baylis (1948). Young plants were common in 1951 (Baylis 1951b), having spread from old trees growing in the valley bottoms. By 1982 the species was a widespread understorey constituent of forest in damper areas. The Three Kings' milk tree does not show the arboreal habit of what is commonly called the large leaved milk tree (*Streblus heterophyllus* (Blume) Corner var. *elliptica* (Kirk) Corner) found on other northern offshore islands; rather it is diffuse, even semi-lianoid, and mature trees resemble untended domestic figs (*Ficus carica* L.) in habit.

Tecomanthe speciosa W.R.B. Oliver

This last of the endemic species was also described from a single plant growing in the TasmanValley (Oliver 1948). At the time of its discovery, all other suitable habitats were easily accessible and searching failed to locate any further plants. Baylis (1951b) reported no evidence of seed production, though the vine had layered itself at one point well removed from the old base. The plant was relocated by Michie (1963) who reported "All accounts I have read concerning this climber have stated that only one vine existed. This however, is not correct; there is a group of four separate flourishing vines, which may have and probably did come from the largest vine originally".

In 1982 the main vine, emanating from a rootstock 5 cm in diameter, was climbing a young pigeonwood (*Hedycarya arborea* J.R. et G.Forst.). Layering has produced rooted vines at a further six points up to 10 m from the original. Despite the increased number of vines, the foliage appeared to be less dense than the early descriptions and illustrations indicate. No flowers or fruit were seen, and no seedlings were found. Although the Three Kings' plant has been observed flowering (Oliver 1948: pl. 33), seed pods have never been seen. As with the *Pennantia*, further research into the breeding system may lead to seed production by the plants growing on Great Island.

DISCUSSION

All the Three Kings Islands' endemic plant taxa were found to be present in numbers equal to or greater than have been seen in the past. Most have shown strong recoveries since the removal of goats in 1946 and now exist in naturally sustainable, sexually reproducing populations. The exceptions are the two species represented by single individuals — *Pennantia baylisiana* (disregarding the planted cutting) and *Tecomanthe speciosa*. Despite the ability of the latter to reproduce vegetatively to a limited degree, their long term future in the wild is not at all certain. However, there is no longer any threat to their absolute survival as both are now recognised as good garden plants and are propagated commercially.

The only other species with an uncertain future is *Myrsine oliveri*. Although the known plants are widely dispersed on Great Island, the total population remains small, perhaps 30 or 40 plants (although only 16 were located in the 1982 survey). The fact that no seedlings were found is further cause for concern. This is also the only species not known in cultivation; seed and cuttings brought back to the mainland in December 1982 had not grown by August 1983.

Vegetation management

Botanically, management of reserves for the conservation of flora and fauna is usually limited to the elimination of any aggressive exotic species that appear. On Great Island this has not, and with reasonable care, should never be necessary. The process of forest regeneration is proceeding naturally from seed sources which are unusually well defined. This exceptionally favourable opportunity for studying dispersal and succession has not been neglected, and the published work (Baylis 1948, 1951b; Holdsworth 1951; Holdsworth & Baylis 1967; Turbott 1948, 1963) adds to the importance of allowing natural change to continue without interference.

Kennedy & Simpson (n.d.) formulated a research proposal in which the objective was "To carry out a survey of the status of rare and endangered plant species on the Three Kings Islands and to undertake a program of rehabilitation". The present survey effectively completed the first part of this proposal, leaving the rehabilitation programme open to debate.

Simpson (n.d.) discussed the question of the rehabilitation of endangered plant species on the Three Kings Islands in more detail and noted some of the reactions generated by the proposal. A major concern regarding the introduction of plants to Great Island lies in the very real risk of introducing pathogenic organisms, especially soil-borne fungi, to a situation where they are so far absent (P.J. Brook pers. comm.). Numerous examples of the devastation caused by, for example, *Phytophthora cinnamomi* root rot have been documented (see Newhook & Podger 1972) and the implications for the Three Kings Islands would be extremely serious.

There is no doubt that efforts must be made to ensure the survival of Three Kings' endemic plant species. However, bearing in mind Great Island's value for study of plant dispersal and succession, any steps involving manipulation of the wild habitat should be on the smallest scale practicable, and then only after substantial agreement amongst scientists from a variety of disciplines. Thus, attempts at low-key management should be made (for example to induce seed production on the existing wild *Pennantia* and *Tecomanthe* on Great Island) before higher impact measures such as replanting programmes are initiated.

As long as present conditions on the Three Kings Islands continue to exist, and all the endemic plant species are maintained in cultivation, the present management policy for the islands' vegetation is sufficient. The obvious priorities, then, are to secure *Myrsine oliveri* in cultivation, and begin research into the breeding systems of the wild populations of *Pennantia baylisiana* and *Tecomanthe speciosa*.

Acknowledgements. I am grateful to Professor G.T.S. Baylis, Dunedin, for his guided tours of the Three Kings' endemic flora and for suggesting improvements to a draft of this paper.

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THE TAXONOMY OF SOME INDO-PACIFIC MOLLUSCA
PART 11

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Abstract. New range extensions are recorded for *Cypraea katsuae* (Kuroda), *Mitra deynzeri* Cernohorsky, *M.bellula* A. Adams, *Vexillum millecostatum* (Broderip) and *Clavus papillosus* (Garrett). On the basis of their type-specimens *Murex brachys* Melville & Standen, is synonymised with *Morula echinata* (Reeve), *Sistrum morus* var. *borealis* Pilsbry, with *Morula japonica* (Sowerby), *Pentadactylus ceylonicum* Preston, with *Cronia contracta* (Reeve), *Bullia strenaria* Melvill, with *B.melanoides* (Deshayes in Bélanger), *Microvoluta ponderi* Cernohorsky, with *M.miranda* (E.A. Smith), and *Hindsia rewaensis* Ladd, with *Neadmete nausorensis* Ladd. Type-specimens of *Thais squamigera* (Deshayes in Bélanger), *Microvoluta teretiuscula* (Thiele) and *Volutomitra hottentotta* (Thiele) are illustrated, and the identity of *Vexillum ochracea* (Hervier) is elucidated and synonymised with *V.exasperatum* (Gmelin).

Family CYPRAEIDAE

Genus **Cypraea** Linnaeus, 1758

Cypraea Linnaeus, 1758, Syst.Nat. ed.10:718. Type species by SD (Montfort, 1810) *C.tigris* Linnaeus, 1758. Recent, Indo-Pacific.

Cypraea (Notadusta) katsuae (Kuroda, 1960) (Figs. 1,2)

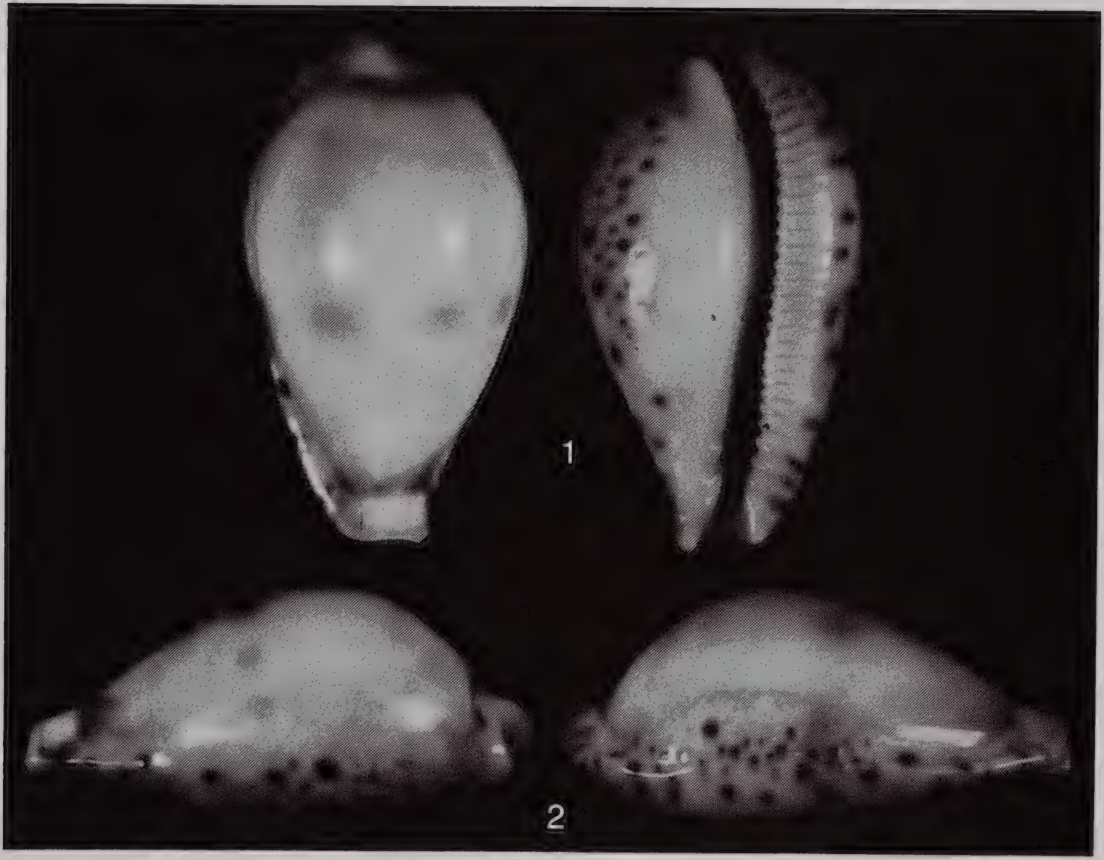
1960. *Erronea (Gratiadusta) katsuae* Kuroda, Cat.moll.fauna Okinawa p.74, pl.3, figs.32-34.
1961. *Notadusta musumea* Kuroda & Habe in Habe, Col.illust.shells Japan 2:42, App.p.14, pl.19,fig.18.
1964. *Notadusta martini katsuae* (Kuroda), Habe, Shells west.Pacif.col. 2:65, pl.19,fig.18.
1970. *Cypraea musumea* Kuroda & Habe, Burgess, Living cowries p.61, pl.4, fig.E; 1982 Abbott & Dance, Compendium Sea-shells p.91, fig.top row right.
1970. *Cypraea katsuae* Kuroda, Burgess, *ibid.*, p.68, pl.4,fig.G; 1979 Walls, Cowries p.240, textfigs.; 1982 Abbott & Dance, Compendium Seashells p.91, fig.second row centre.

TYPE LOCALITY. Okinawa I, Ryukyu Is *(katsuae);* Tosa Bay, Shikoku, Japan *(musumea).*

DISTRIBUTION. Japan to the Philippines. Now Solomon Is.

A specimen of the very rare *C.katsuae* (Kuroda) has been recently obtained *ex-pisces* at Marova lagoon, New Georgia I, Solomon Is, by Mr. and Mrs G. Lee. The specimen must have been only recently ingested by the fish since it shows no sign of decortication or dulling. The specimen measures length 17.6 mm, width 9.6 mm, there are 29 brown teeth on the outer lip and 28 on the columella; the shell is apricot coloured, with 2 interrupted faint bands on dorsum, a brown collar at the anterior extremity and brown spotting on the sides. The specimen lacks a fossula.

Rec. Auckland Inst. Mus. 20: 185-202 23 December 1983



Figs. 1,2. *Cypraea (Notadusta) katsuae* (Kuroda). Marova lagoon, New Georgia I, Solomon Is; 17.6 mm. 1. Dorsal and ventral views. 2. Lateral views.

There is some taxonomic confusion concerning the species *C.katsuae* and *C.musumea*. Habe (1964) himself placed *C.musumea* in synonymy of *C.katsuae* as a form, and considered the latter to be a subspecies of *C.martini* Schepman, 1907. Burgess (1970) and Abbott & Dance (1982) consider them to be distinct species, while Walls (1979) treats them as conspecific. The two species are separated on the basis of either presence or absence of fossula, but the reliability of this character is somewhat suspect and further research is indicated.

Family MURICIDAE

Subfamily THAIDINAE

Genus **Thais** Röding, 1798

Thais Röding, 1798, Mus.Bolten. p.54. Type species by SD (Stewart, 1927) *T.lena* Röding, 1798 = *Nerita nodosa* Linnaeus, 1758.

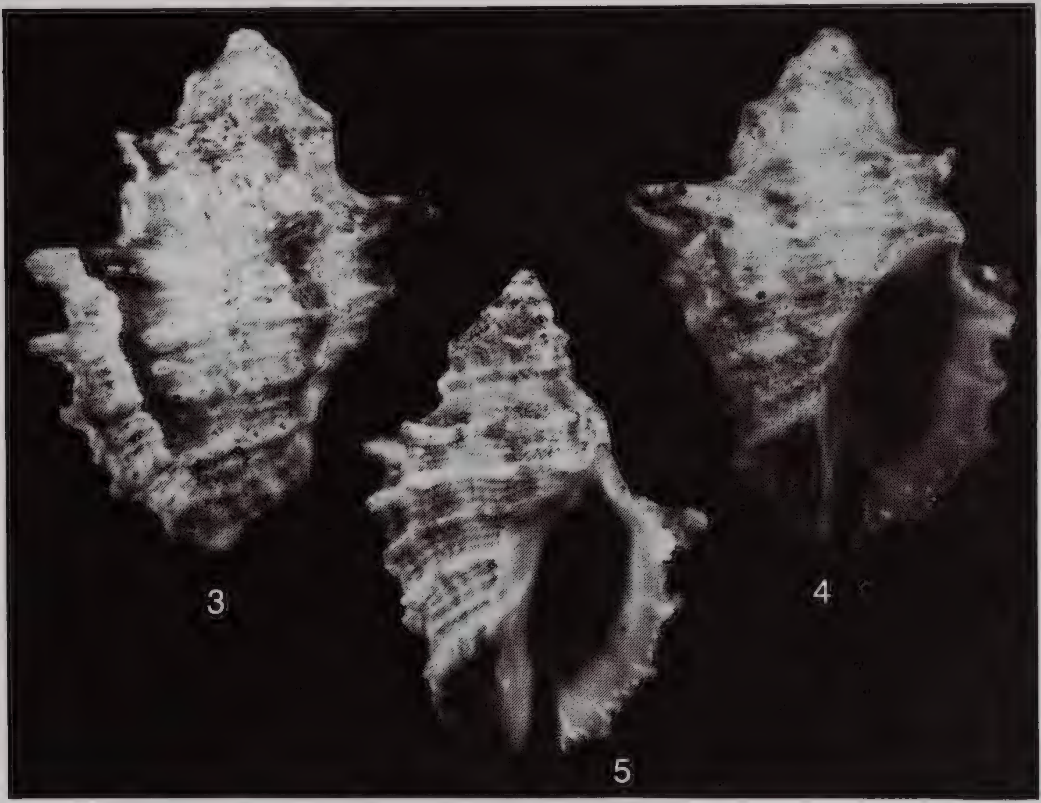
Thais squamigera (Deshayes in Belanger, 1832) (Figs.3-5)

1832. *Purpura squamigera* Deshayes in Bélanger, Voy.Indes-Orient.,Zool.Moll. p.426, pl.13,figs.10-12 (spelled *squamata* on plate); 1844 Deshayes & Edwards, His.nat.anim.s.vert. ed.2, 10:103.

TYPE LOCALITY. Iles de la Sonde [= Sunda Is, Indonesia].

Type specimens. Three syntypes of *Purpura squamigera* Deshayes are in the Museum National d'Histoire Naturelle, Paris. One of the larger syntypes, length 30.4 mm, width 22.5 mm, has *c*. 5 whorls, 9 axial folds on the penultimate and 7 on the body whorl, 1 spiral row of echinate fronds on the penultimate and 5 rows on the body whorl; the outer lip has 5 lirate denticles and the columella is smooth and brown, exterior of shell dirty white, with some fronds blackish-brown (Figs. 3,4). Dimensions of smaller syntype length 24.9 mm (Fig. 5).

Tryon (1880) erroneously synonymised *Purpura squamigera* Deshayes with "*Ricinula undata* Chemnitz" (= *Cronia margariticola* Broderip). The species is similar to *Thais rugosa* (Born,1778) and differs from that species mainly in the chocolate-brown aperture of *Thais squamigera*.



Figs. 3-5 *Thais squamigera* (Deshayes in Bélanger). Sunda Is, Indonesia. Syntypes Museum National d'Histoire Naturelle, Paris. 3,4. 30.4 mm. 5. 24.9 mm.

Genus **Morula** Schumacher, 1817

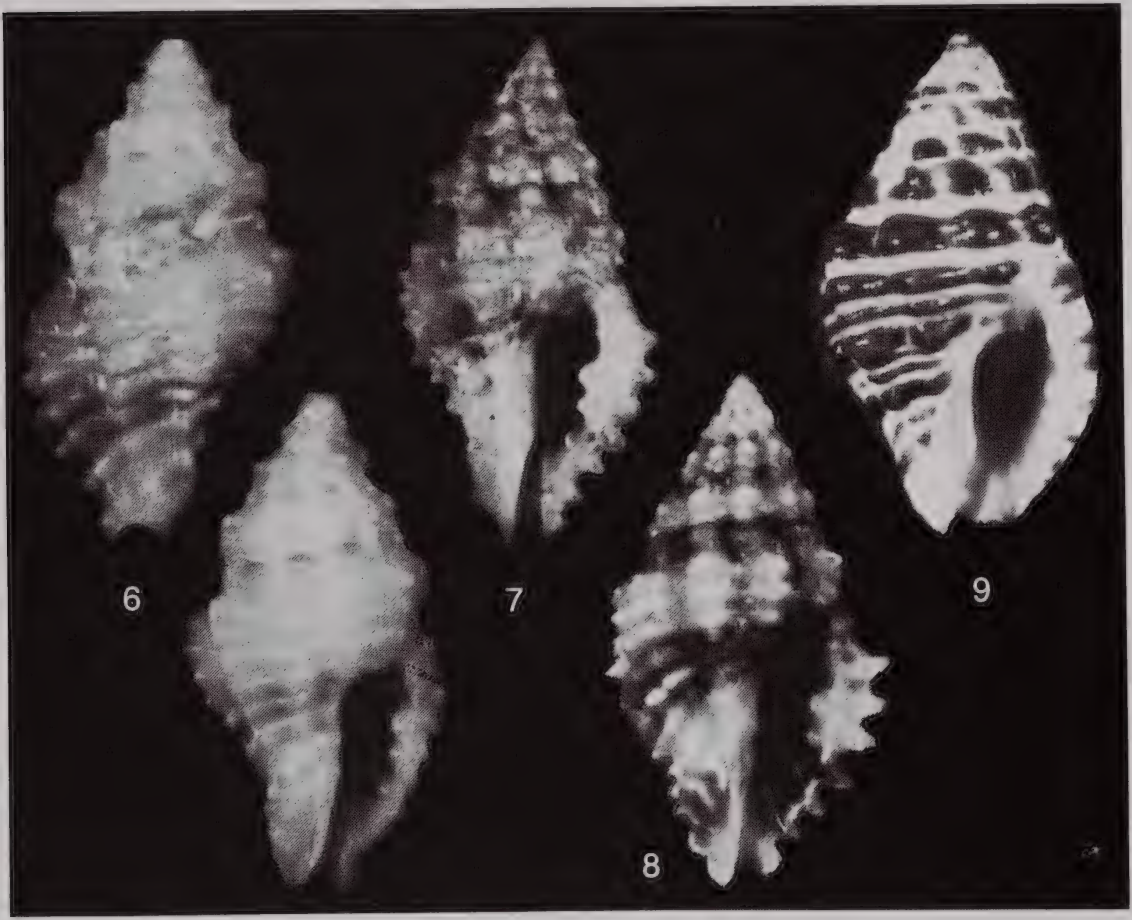
Morula Schumacher, 1817, Essai nouv.syst. pp.68,227. Type species by M *M.papillosa* Schumacher, 1817 = *Drupa uva* Röding, 1798. Recent, Indo-Pacific.

Morula brachys (Melvill & Standen, 1896) (Figs. 6-8)

1896. *Murex (Ocinebra) brachys* Melvill & Standen, J.Conch. 8:273, pl.9, fig.1.

TYPE LOCALITY. Lifu, Loyalty Is.

Type specimens. The holotype of *Morula brachys* (Melvill & Standen) is in the University of Manchester Museum, length 6.6 mm, width 3.3 mm. The type is worn and faded, has 6



Figs. 6-9. 6-8 *Morula echinata* (Reeve). 6. Holotype of *Murex brachys* Melvill & Standen, Manchester University Museum; 6.6 mm. 7. Holotype of *Ricinula echinata* Reeve, BM(NH) No.1968456; 9.3 mm. 8. Specimen from Faaone, Tahiti; 6.9 mm. 9. Syntype of *Morula funiculata* (Reeve), BM(NH) No.1968475; 17.0 mm.

whorls, 9 axial folds on the penultimate and 8 on the body whorl, penultimate whorl with 2 rows of nodulose cords, body whorl with a sutural row of nodules followed by a concave subsutural area and 7 nodulose cords, outer lip with 5 denticles, columella with 2 small denticles; faded cream in colour with an indication of a darker peripheral band on body whorl and darker spots between sutural nodules.

Although the type of *M.brachys* is worn and faded (Fig. 6), it is still recognizable as being conspecific with *M.echinata* (Reeve, 1846) [Figs. 7,8], of which *Engina monilifera* Pease, 1860, is another synonym. Kay (1979) erroneously illustrated the species under the name "*Morula funiculata* Reeve", and placed *M.echinata* (Reeve) in synonymy. The real *M.funiculata* (Reeve), however, is appreciably different, and the syntype from the British Museum (Nat.Hist.) No. 1968475, length 17.0 mm, is here illustrated (Fig. 9).

Morula japonica (Sowerby, 1903) (Figs. 10-12)

1903. *Pentadactylus japonicus* Sowerby, Ann.Mag.Nat.Hist. (7) 12:496.
1904. *Sistrum (Ricinula) morus* var. *borealis* Pilsbry, Proc.Acad.Nat.Sci. Philadelphia 56(1):18, pl.3,fig.31.
1952. *Drupa borealis* (Pilsbry), Kuroda & Habe, Check-list Moll.Japan p.54.
1960. *Drupa (Morula) borealis*)Pilsbry), Azuma, Cat.moll.Okinoshima, Japan p.36.

TYPE LOCALITY. Tanabe, Kii, Japan *(japonica);* Hachijojima, Izu, Japan *(borealis).*

Type specimens. The holotype of *M.japonica* (Sowerby) is in the British Museum (Nat.Hist.) No.1903.12.7.12., length 13.3 mm, width 8.0 mm. The shell is whitish, with a light violet aperture (Fig. 10). Syntypes of *Sistrum borealis* Pilsbry, are in the Academy of Natural Sciences, Philadelphia, No.85982, and the specimen illustrated by Pilsbry (1904), length 13.9 mm, width 8.0 mm, is here illustrated (Fig.11).

Kuroda & Habe (1952) placed *Pentadactylus japonicus* Sowerby, in the synonymy of *Drupa aspera* Lamarck (= *Morula uva* Röding, 1798), and listed *Drupa borealis* (Pilsbry) as a good species. *Morula japonica* (Sowerby) and *borealis* Pilsbry are, however, conspecific and the species bears a much closer resemblance to *M.spinosa* (H. & A. Adams) than it does to *M.uva.*

Genus **Cronia** H. and A. Adams, 1853

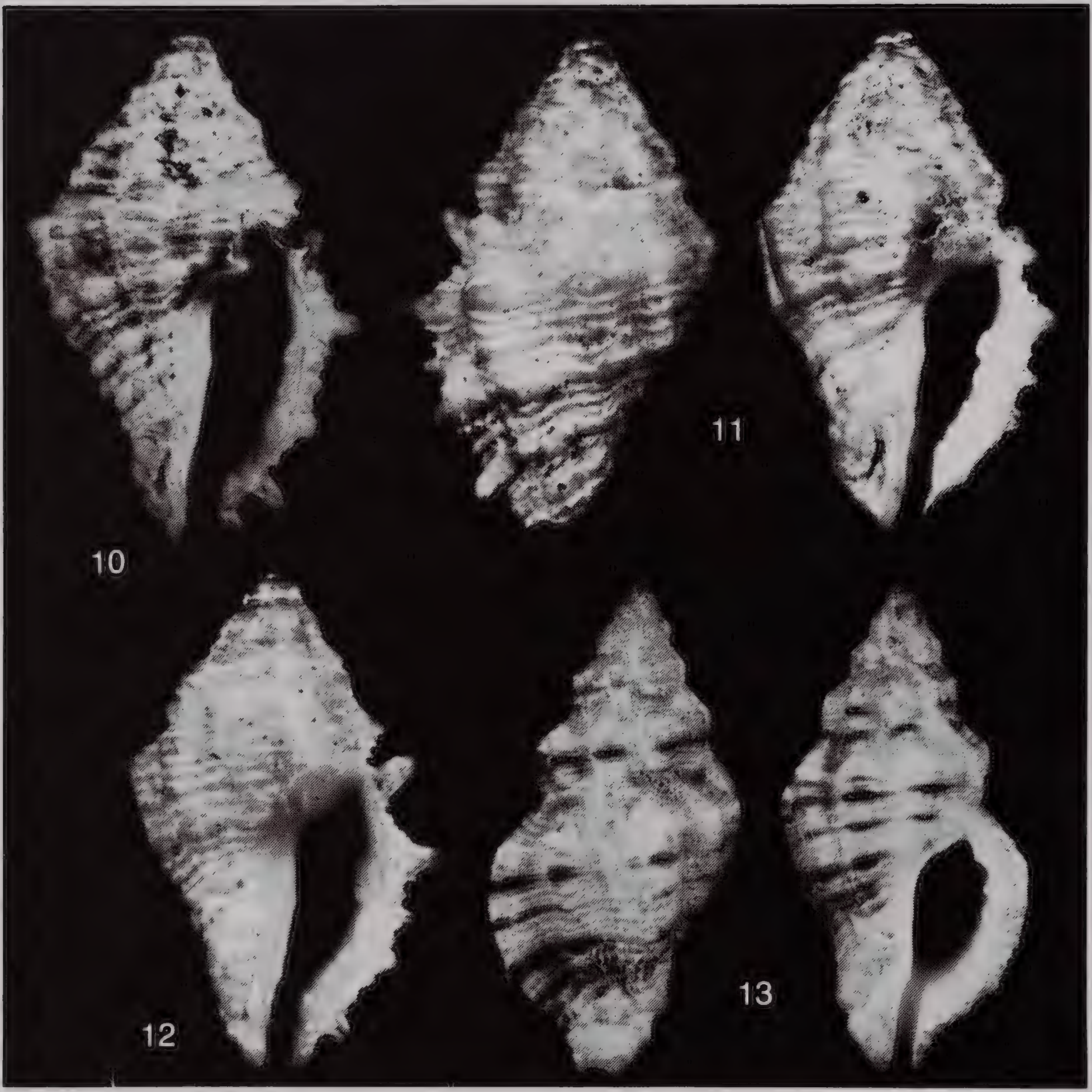
Cronia H. & A. Adams, 1853, Gen.Rec.Moll, 1:128. Type species by M *Purpura amygdala* Kiener, 1835. Recent, Indo-Pacific.

Cronia (Ergalatax) contracta (Reeve, 1846) (Fig. 13)

1846. *Buccinum contractum* Reeve, Conch.Iconica 3:pl.8,fig.53.
1909. *Pentadactylus ceylonicum* Preston, Rec.Indian Mus. 3(2):137, pl.22,fig.17.
1976. *Cronia (Ergalatax) contracta* (Reeve), Cernohorsky, Rec.Auckland Inst.Mus. 13:123, figs.37-41 (extended synonymy).

TYPE LOCALITY. Samar I, Philippines *(contracta);* Ceylon [= Sri Lanka] *(ceylonicum).*

Type specimens. The holotype of *Pentadactylus ceylonicum* Preston, is in the British Museum (Nat.Hist.), No. 1915.1.6.64., length 20.1 mm, width 10.0 mm. The type has 6



Figs. 10-13. 10-12 *Morula japonica* (Sowerby). 10. Holotype BM(NH) No. 1903.12.7.12.; 13.3 mm. 11,12. Syntypes of *Sistrum borealis* Pilsbry, Academy Natural Sciences, Philadelphia No.85982 (11. = 13.9 mm; 12. = 12.6 mm). 13. *Cronia (Ergalatax) contracta* (Reeve). Holotype of *Pentadactylus ceylonicum* Preston, BM(NH) No.1915.1.6.64.; 20.1 mm.

+ whorls, 10 axial folds and 12 spiral threads on the penultimate and 9 axial folds (inclusive of 2 varices) and 21 spiral cords on the body whorl, 7 denticles on the outer lip and 4 minute denticles at the base of the columella (Fig. 13).

The type of *P.ceylonicum* Preston, is a slender individual of *Cronia contracta* (Reeve) and this taxon should be added to the already extensive synonymy of that variable species.

Family NASSARIIDAE

Subfamily DORSANINAE Cossmann, 1901

Genus **Bullia** Gray in Griffith and Pidgeon, 1834

Bullia Gray in Griffith & Pidgeon, 1834, Anim.Kingd.Bar.Cuvier, Moll.&Rad. 12: pl.37, fig. 8. Type species by M *B.semiplicata* Gray in Griffith & Pidgeon, 1834 = *B.callosa* Wood, 1828. Recent, Sth. Africa.

Bullia melanoides (Deshayes in Bélanger, 1832) (Figs. 14-19)

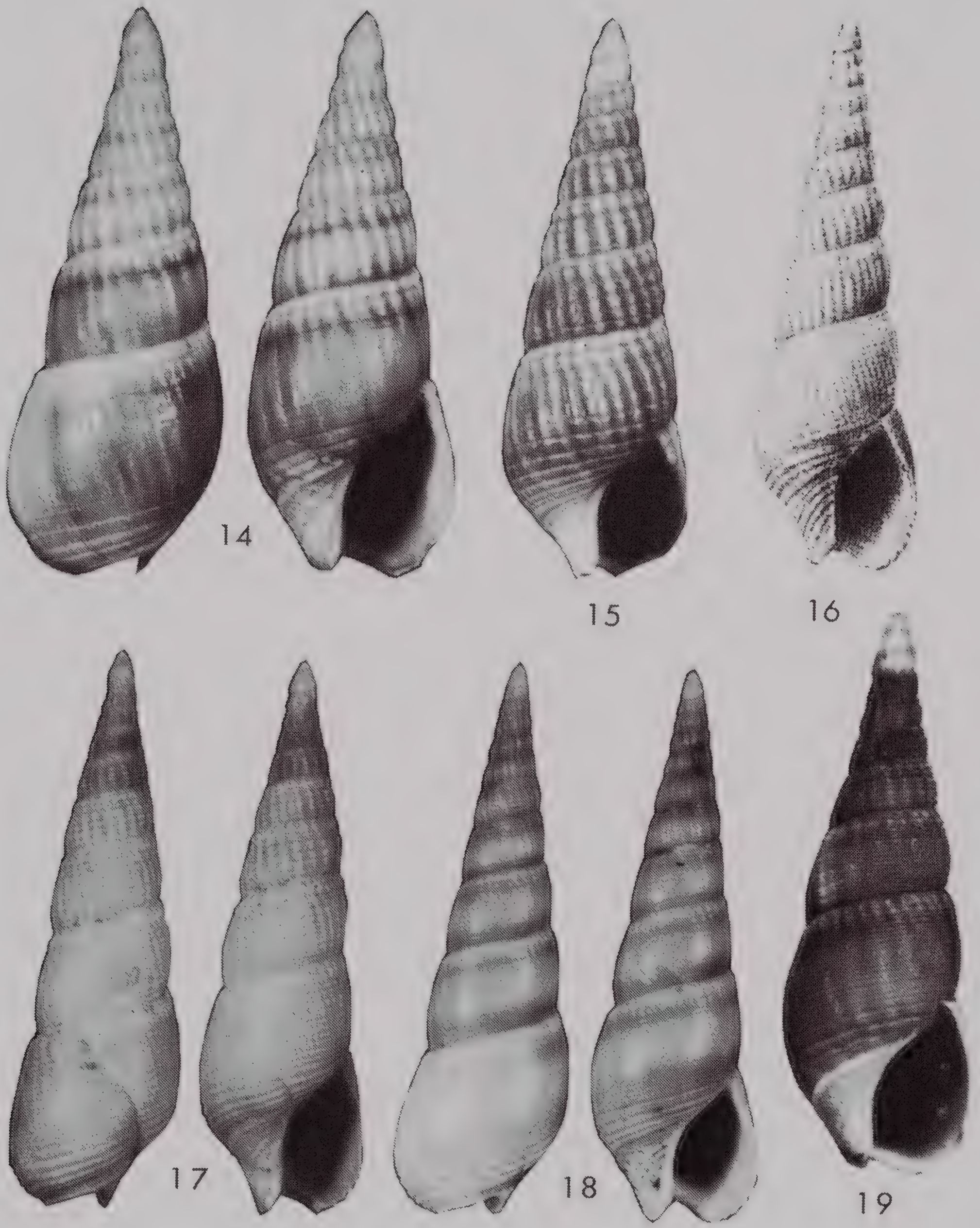
1832. *Buccinum melanoides* Deshayes in Bélanger, Voy.Indes-Orient. p.430, pl.2, figs.3,4.
1904. *Bullia (Pseudostrombus) strenaria* Melvill, Proc.Malac.Soc.Lond. 6:51, pl.5, fig.10.
1904. *Bullia (Pseudostrombus) strenaria* var.b. *melaleuca* Melvill, *ibid.*, 6:52.
1904. *Bullia (Pseudostrombus) strenaria* var.c. *plumbea* Melvill, *ibid.*, 6:52.

TYPE LOCALITY. Ceylon [= Sri Lanka] *(melanoides);* Ormara Beach, Persian Gulf *(strenaria);* Galig I, 8 fathoms (15 m) [*melaleuca*]; Persian Gulf *(plumbea)*.

Type specimens. Five syntypes of *Bullia melanoides* (Deshayes) are in the Museum National d'Histoire Naturelle, Paris, dimensions of illustrated syntypes length 20.4 mm, width 7.3 mm (fig. 14) and 20.3 mm x 6.7 mm (Fig. 15). Syntypes have a teleoconch of 6½ — 8 whorls, a protoconch of 2½ — 3½ calloused embryonic whorls, 20-23 axial ribs on the penultimate and 21-35 on the body whorl; some specimens become smoother on last 2 whorls while others are distinctly granulose. Bluish-grey, with a darker narrow subsutural band or brown, with a whitish apex and siphonal fasciole.

A tablet originally containing specimens of *B.strenaria* Melvill, marked "Persian Gulf" is in the British Museum (Nat.Hist.), London. Two specimens BM(NH) No.1898.3.16.4-5., were presented by Melvill to the British Museum under the name "*B.persica*", and one specimen ex-Sowerby & Fulton, BM(NH) No.1904.7.29.58., as *B.strenaria*. Only two specimens are remaining, and the specimen measuring length 30.0 mm, width 9.0 mm, which appears to be the specimen illustrated by Melvill (1904, pl.5,fig.10 — 30.0 x 10.0 mm) is here selected as the lectotype of *B.strenaria* Melvill (Fig. 17).

Another tablet in the British Museum (Nat.Hist.) *ex*-W. D. Cumming's collection from Bushire, contains four specimens, and the two centre specimens are probably syntypes of Melvill's var. *plumbea* (Fig. 19). Another specimen ex-F.W. Townsend collection from Karachi in the British Museum (Nat.Hist.), is probably the syntype of Melvill's var. *melaleuca* (Fig. 18).



Figs. 14-19. *Bullia melanoides* (Deshayes in Bélanger). 14. Syntype Museum National d'Histoire Naturelle, Paris; 20.4 mm. Broad form. 15. Another syntype 20.3 mm. Slender, granulose form. 16. Type-figure of *B.strenaria* Melvill; 30.0 mm (from Melvill, 1904, pl.5, fig.10). 17. Lectotype of *B.strenaria* Melvill, BM(NH) No.1898.3.16.4-5.; 30.0 mm. 18. Probable syntype of *B.strenaria* var. *melaleuca* Melvill, from Karachi; 33.1 mm. Smooth, slender form. 19. Probable syntype of *B.strenaria* var. *plumbea* Melvill. from Bushire; 19.8 mm.

Melvill's mention of "*Bullia persica*" was an error, since *B.persica* E.A. Smith, 1878, is a *Cyllene*-like *Bullia* which is appreciably different to Melvill's *B.strenaria*. The species *B.melanoides* (Deshayes in Bélanger) is a variable species, similarly to other species of the genus, and *B.strenaria* Melvill, together with its varieties, falls within the variational range of *B.melanoides*.

B.cataphracta Kilburn, 1978, from Mozambique, may prove to be another synonym of *B.melanoides* (Deshayes). The holotype of *B.cataphracta* is closely similar to the granulose syntype of *B.melanoides* illustrated here, and Kilburn (1978) also mentions that the colouring of *B.cataphracta* may vary from white to deep reddish-brown.

Family MITRIDAE

Genus **Mitra** Lamarck, 1798

Mitra Lamarck, 1798, Tabl.Encycl.Méth. pl.369. Type species by T *Voluta mitra* Linnaeus, 1758 (Opinion 885 of ICZN). Recent, Indo-Pacific.

Mitra deynzeri Cernohorsky, 1980 (Fig. 20)

1980. *Mitra deynzeri* Cernohorsky, Rec.Auckland Inst.Mus. 17:145, figs.20-22.

TYPE LOCALITY. Seragaki area of west coast of Okinawa I, Ryukyu Is, Japan, 37-43 m.

DISTRIBUTION. Philippines to the Ryukyu Is and Papua New Guinea. Now Reunion Is.

A not fully mature specimen of *M.deynzeri* collected by Mr J.C. Martin at Reunion I, Indian Ocean, length 20.7 mm (Fig. 20), is a considerable westward range extension into the Indian Ocean.

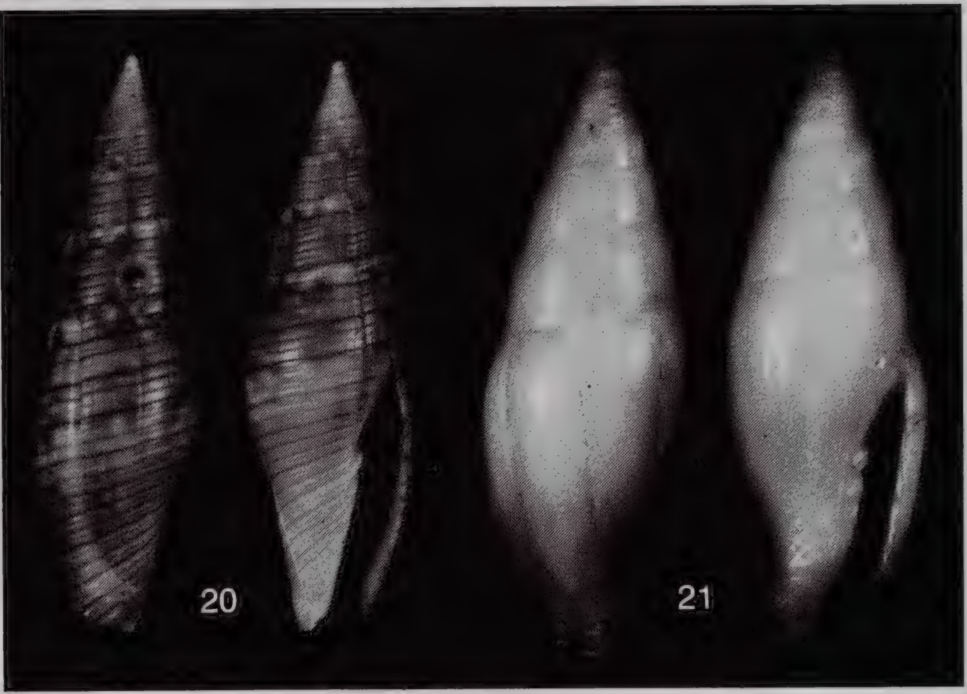
Mitra (Strigatella) bellula A.Adams, 1853 (Fig. 21)

1853. *Mitra bellula* A.Adams, Proc.Zool.Soc.Lond. for 1851:138.
1976. *Mitra (Strigatella) bellula* A.Adams, Cernohorsky, Indo-Pacific Moll. 3(17):499, pl. 499 (figd. holotype).

TYPE LOCALITY. Capul I, Philippines.

To date the species has been known only from the holotype, and this led to the assumption that *M.bellula* may represent an aberrant individual of a previously described species. A specimen of this species has been recently collected at West reef, Kwajalein I, Marshall Is, in 12 m, by Mr M. McDonald, length of specimen 12.4 mm. This specimen, although collected devoid of animal, closely resembles the holotype and also shows 3 growth-scars on the dorsal side of the body whorl, as in the holotype, but it lacks the dark brown spots at the sutures.

The Marshall I record tentatively confirms *M.bellula* as a valid species, pending collection of living specimens.



Figs. 20,21. 20. *Mitra deynzeri* Cernohorsky. Reunion I, Indian Ocean; 20.7 mm. 21. *M.bellula* A.Adams. West reef, Kwajalein I, Marshall Is, 12 m; 12.4 mm.

Family COSTELLARIIDAE

Genus **Vexillum** Röding, 1798

Vexillum Röding, 1798, Mus.Bolten. p.138. Type species by SD (Woodring, 1928) *V.plicatum* Röding, 1798 = *Voluta plicaria* Linnaeus, 1758. Recent, Indo-Pacific.

Vexillum (Costellaria) ochracea (Hervier, 1897) (Figs. 22,23)

1897. *Mitra (Costellaria) ochracea* Hervier, J.Conchyl. 45(1):63; 1898 Hervier, J.Conchyl. 45(4):238, pl.10, figs.3,3a.

1981. *Vexillum (Costellaria) ochracea* (Hervier), Cernohorsky, Bull.Mus.nat. Hist.nat.Paris (4) 3(1):97, pl.2, fig.7.

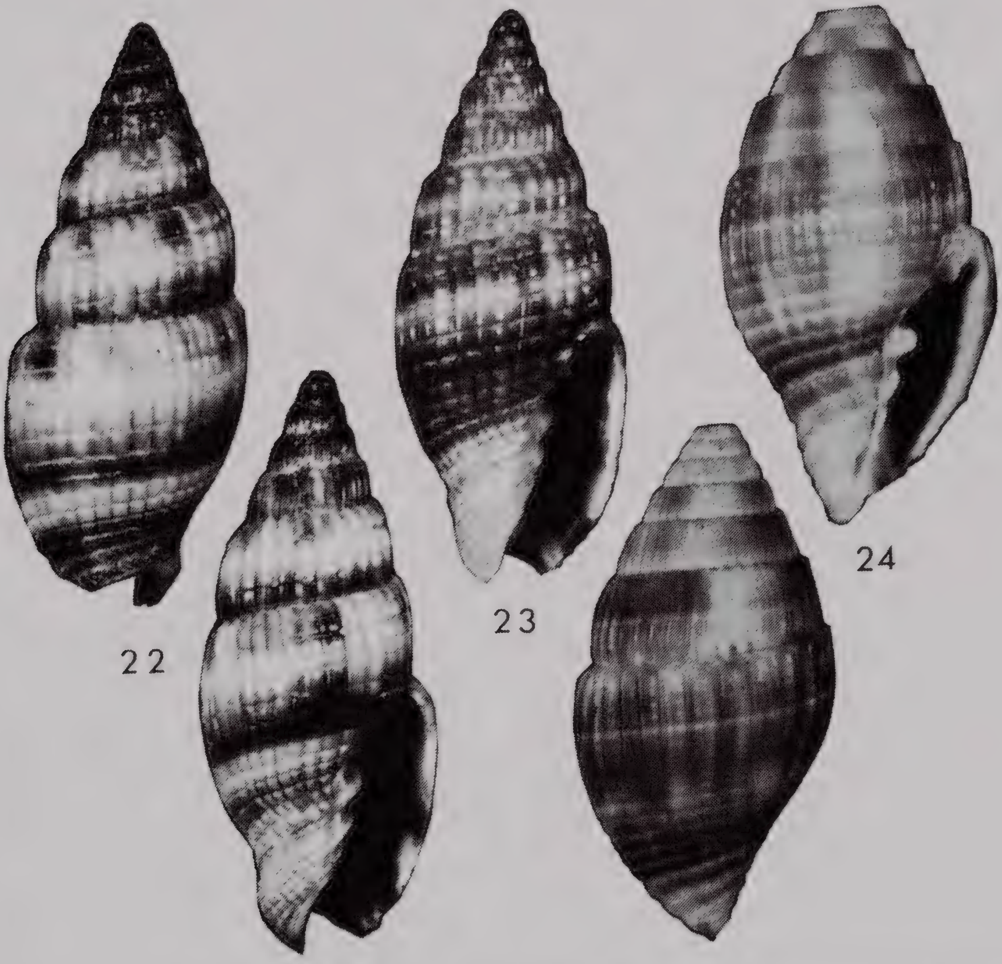
TYPE LOCALITY. New Caledonia.

In a revision of J. Hervier's type-specimens of Mitracea from New Caledonia and the Loyalty Is (Cernohorsky, 1981) it was pointed out that the types of *Mitra ochracea* could not be found, and it was suggested that the species could be a worn *Vexillum (Pusia) infaustum* (Reeve, 1845).

Ms K. Way, British Museum (Nat.Hist.), London, located three specimens labelled "*Mitra ochracea* Hervier", No.1907.5.3.114-116. Although these specimens are not documented type-material, they closely conform to the original diagnosis and illustration and may possibly have originated from either Hervier's or Melvill & Standen's New Caledonia — Loyalty Is collection.

The specimens are either whitish and banded with brown, or brown in colour and banded with white. The numerous, low axial ribs are separated by longitudinal grooves and also incised by fine spiral striae, the columella is plicate and the aperture has granulose lirae on the outer lip wall.

The specimens conform very well with the original diagnosis of *Mitra ochracea* Hervier. They also represent a low-ribbed dwarf form of the highly variable *Vexillum (Costellaria) exasperatum* (Gmelin, 1791), and this synonymy is now established.



Figs. 22-24. 22,23. *Vexillum (Costellaria) exasperatum* (Gmelin). Specimens from British Museum (Nat.Hist.) No.1907.5.3.114-115., labelled "*Mitra ochracea* Hervier" from New Caledonia; 10.0 mm and 8.5 mm respectively. 24. *V. (Pusia) millecostatum* (Broderip). Sand I, Oahu, Hawaiian Is. Dorsal view = 26.6 mm; ventral view = 24.8 + mm.

Vexillum (Pusia) millecostatum (Broderip, 1836) (Fig. 24)

1836. *Tiara millecostata* Broderip, Proc. Zool.Soc.Lond. Pt.3:195.
1839. *Mitra antonii* Küster, Martini & Chemn.Syst.Conch.-Cab. ed.2, 5(2):77, pl.14, figs.11-13.
1844. *Mitra adamsoni* Reeve, Conch.Iconica 2:pl.19, sp.150.
1845. *Mitra crocea* Reeve, *ibid.*, 2:pl.38, sp.320.
1895. *Mitra evelynae* Melvill, Proc.Malac.Soc.Lond. 1(5):221, pl.14, fig.1.
1969. *Vexillum (Pusia) millecostatum* (Broderip), Cernohorsky, Hawaiian Shell News 17)12): 1, figs.3a,b (figd.syntypes).
1982. *Vexillum millecostatum* (Broderip), Abbott & Dance, Compendium Seashells p.207, bottom row, fig. on left.

TYPE LOCALITY. Anaa I, Tuamotu Archipelago *(millecostatum);* none *(antonii);* Capul I, Philippines *(adamsoni* and *crocea);* Mauritius *(evelynae).*

DISTRIBUTION. From Mauritius through the tropical Indo-Pacific to the Tuamotu Archipelago. Now Hawaiian Is.

Kay (1979) does not report the species from the Hawaiian Is, but two dead specimens have been recently collected by Dr. W. Haas on Sand I, Oahu, Hawaii, and another was found in beach-rubble by Mr R. Gage in 1981.

Family VOLUTOMITRIDAE

Genus **Microvoluta** Angas, 1877

Microvoluta Angas, 1877, Proc.Zool.Soc.Lond. p.34. Type species by M *M.australis* Angas, 1877. Recent, S.E. Australia.

Microvoluta miranda (E.A. Smith, 1891) (Figs. 25-27).

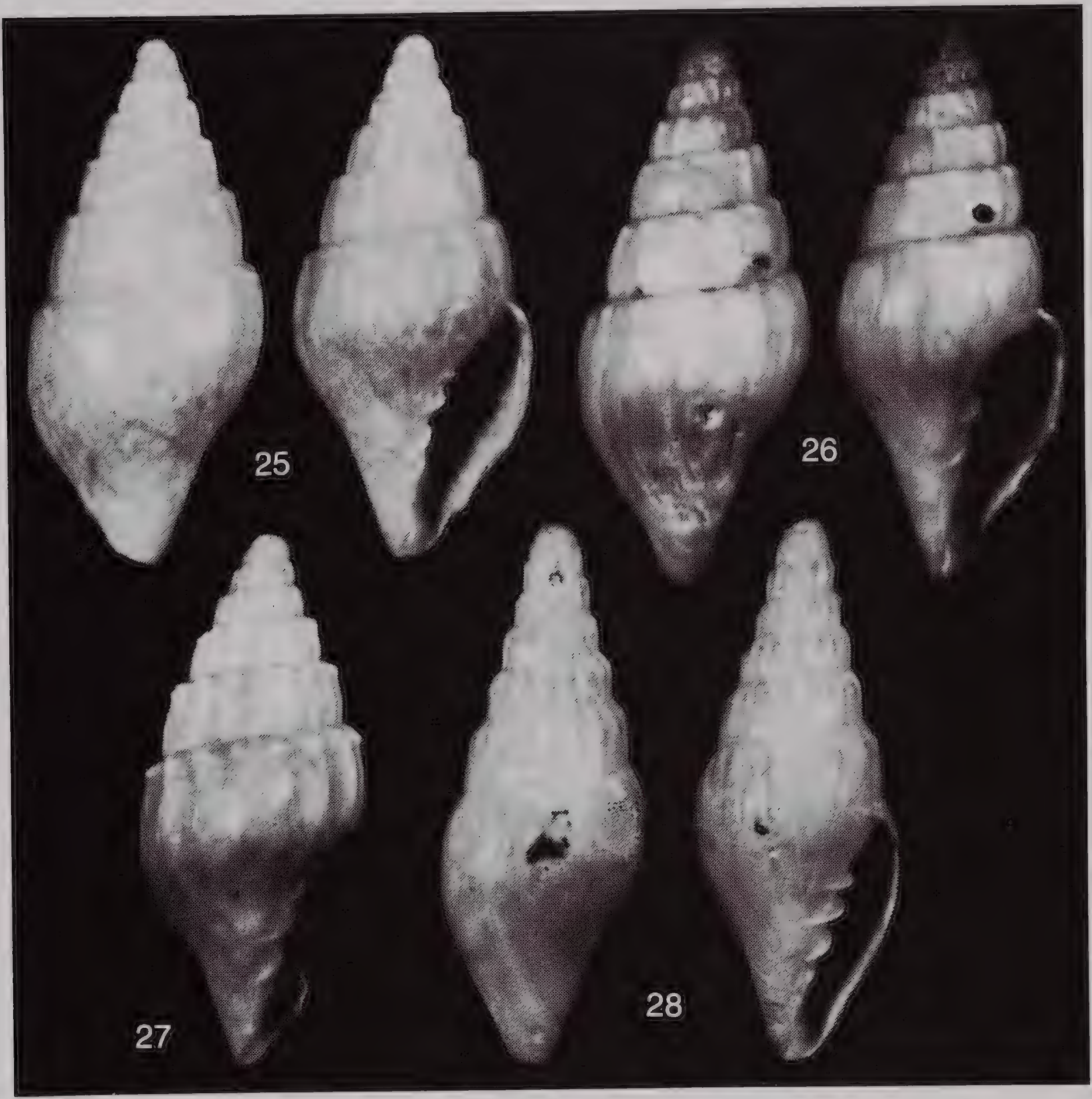
1891. *Mitra miranda* E.A. Smith, Proc.Zool.Soc.Lond. p.440, pl.34,fig.12.
1970. *Microvoluta intermedia* (Dall), Cernohorsky *(pars),* Bull.Auckland Inst. No.8:120, pl.15, fig.6 only (non *Conomitra intermedia* Dall, 1890).
1975. *Microvoluta ponderi* Cernohorsky, Rec.Auckland Inst.Mus. 12:227, figs. 42-46.

TYPE LOCALITY. Station 164B, off Sydney, New South Wales, Australia, 410 fathoms (750 m) [*miranda*]; East of Port Jackson, New South Wales, Australia, 118 m *(ponderi).*

Type specimens. Eight syntypes of *Microvoluta miranda* (E.A. Smith) are in the British Museum (Nat.Hist.), No.1889.10.12.17-24., and the specimen measuring length 7.8 mm, width 3.6 mm, is here designated as the lectotype (Fig. 25). The holotype of *M.ponderi* Cernohorsky, is in the Australian Museum, Sydney, No. C-98330, length 11.0 mm.

Several writers expressed their doubts as to the true locality of Station 164B, because of the presence of several undoubted Atlantic forms of molluscs in the dredge-haul. Hedley (1901) discussed the problem at length and suggested an elimination of species of Station 164B from the Australian fauna.

This writer followed Hedley's suggestion and associated *M.miranda* with *M.intermedia* (Dall) from Guadaloupe, West Indies (Fig. 28). However, subsequent collection of more material of *M.ponderi* by Dr. Ponder proved the Sydney locality for *M.miranda* to be correct, and this taxon becomes the prior name for the species under discussion, with *M.ponderi* Cernohorsky, as its synonym.



Figs. 25-28. 25-27. *Microvoluta miranda* (E.A. Smith). Off Sydney, Australia. 25. Lectotype BM(NH) No.1889.10.12.17.; 7.8 mm. 26. Paralectotype BM(NH) No. 1889.10.12.18.; 8.3 mm. 27. Incomplete, axially ribbed paralectotype BM(NH) No.1889.10.12.19.; 7.8 mm. 28. *M.intermedia* (Dall). Guadaloupe I, West Indies, 908 m. Holotype National Museum Natural History, Washington, No. USNM-97102; 15.0 mm.

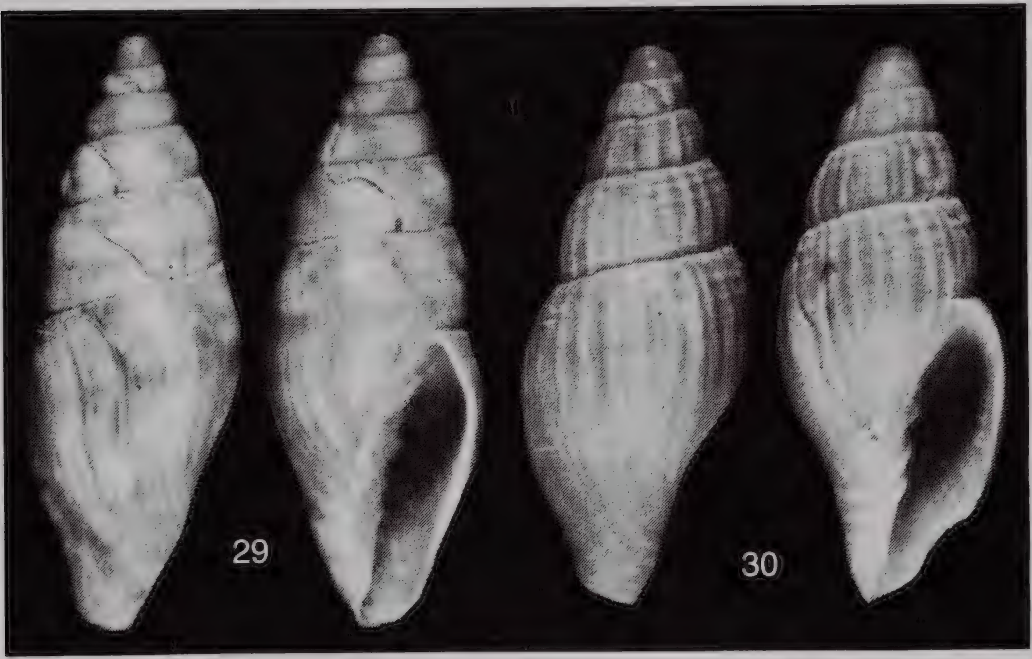
Microvoluta teretiuscula (Thiele, 1925) (Fig. 29)

1925. *Mitra teretiuscula* Thiele, Wiss.Ergeb.Deut.Tief.-Exp. "Valdivia" 17(2): 185, pl.20, fig.23.
1970. *Microvoluta teretiuscula* (Thiele), Cernohorsky, Bull.Auckland Inst.Mus. No.8:120, pl.15, fig.8.

TYPE LOCALITY. Station 104, Agulhas Bank, South Africa, 35°16'S & 22°26.7'E, in 155 m.

Type specimens. The holotype of *M.teretiuscula* (Thiele) is in the Zoological Museum, Humboldt University, Berlin, length 8.3 mm, width 3.2 mm. The penultimate whorl and ante-penultimate whorl as well as first post-embryonic whorl have arcuate repair scars (Fig. 29).

The holotype confirms the correct re-assignment of *Mitra teretiuscula* to the genus *Microvoluta*.



Figs, 29,30. 29. *Microvoluta teretiuscula* (Thiele). Agulhas Bank, Sth.Africa, 155 m. Holotype Zoological Museum, Humboldt University, Berlin; 8.3 mm. 30. *Volutomitra hottentotta* (Thiele). Agulhas Bank, Sth. Africa, 155 m. Holotype Zoological Museum, Humboldt University, Berlin; 7.8 mm (photos courtesy Zoological Museum, Humboldt University, Berlin).

Genus **Volutomitra** H. and A. Adams, 1853

Volutomitra H. & A. Adams, Gen.Rec.Moll. 1:172. Type species by SD (Tryon, 1882) *Mitra groenlandica* Beck in Möller, 1842. Recent, Arctic Seas.

A chronologically prior type designation by Tryon (1882) has been found, and the designation has been emended accordingly.

Volutomitra hottentotta (Thiele, 1925) (Fig. 30)

1925. *Turricula hottentotta* Thiele, Wiss.Ergeb,Deut.Tief.-Exp. ''Valdivia'' 17(2):186, pl.20,fig.24.
1970. *Microvoluta hottentotta* (Thiele), Cernohorsky, Bull.Auckland Inst.Mus. No.8:124, pl.15,fig.9.

TYPE LOCALITY. Station 104, Agulhas Bank, South Africa, 35°16'S & 22°26.7'E, in 155 m.

Type specimens. The holotype of *V.hottentotta* (Thiele) is in the Zoological Museum, Humboldt University, Berlin, length 7.8 mm, width 3.3 mm (Fig. 30).

The holotype of *''Turricula hottentotta''* shows that it must be re-assigned to *Volutomitra* H. & A. Adams.

Family CANCELLARIIDAE

Genus **Neadmete** Habe, 1961

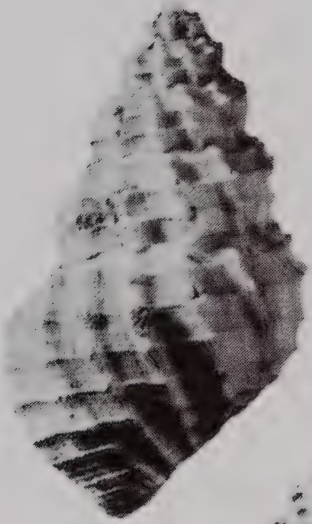
Neadmete Habe, 1961, Col.illust.shells Japan 2:App.p.28. Type species by OD *''Cancellaria japonica* E.A. Smith, Habe, 1961'' (non E.A. Smith, 1879) = *Neadmete okutanii* Petit, 1974. Recent, Japan.

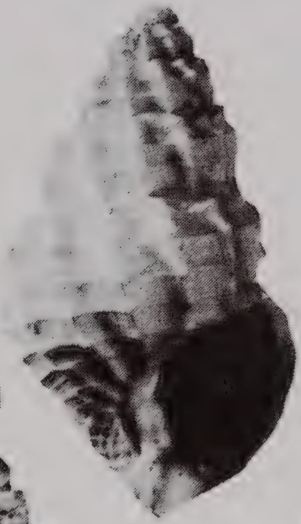
Neadmete nausorensis Ladd, 1982 (Figs. 31-33)

1982. *Neadmete nausorensis* Ladd, U.S.Geol.Surv.Prof.Pap. 1171:58, pl.14, figs. 19-22.
1982. *Hindsia rewaensis* Ladd, U.S.Geol.Surv.Prof.Pap. 1171:47, pl.11, figs. 10,11.

TYPE LOCALITY. St. C2026, near Nausori, Viti Levu, Pliocene of the Fiji Is *(nausorensis* and *rewaensis)*.

Through some unexplained oversight, the late Dr. Ladd (1982) described one and the same species twice as new and placed it in different families and genera. The described *''Hindsia rewaensis''* does not belong to the buccinid genus *Hindsia (=Nassaria* Link*)*, but is clearly conspecific with the cancellarid *Neadmete nausorensis* from the same locality.





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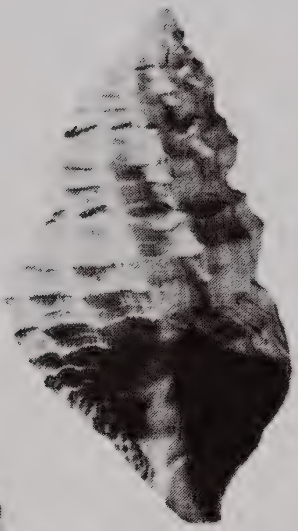

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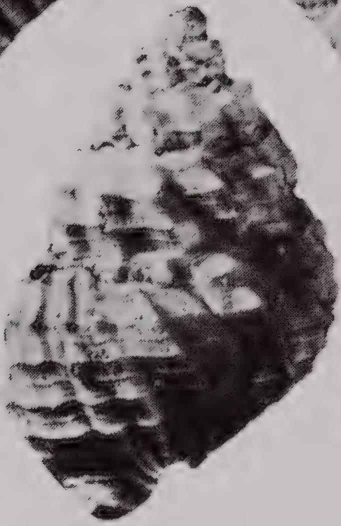

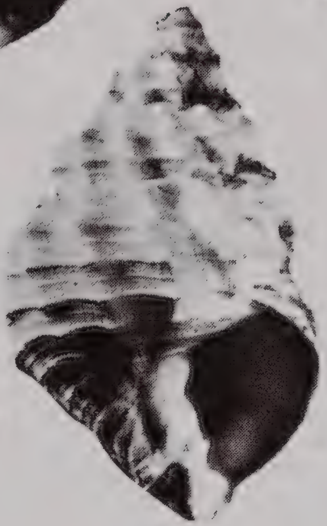

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Figs. 31-33. *Neadmete nausorensis* Ladd. Near Nausori, Viti Levu, Pliocene of Fiji. 31. Holotype National Museum of Natural History, Washington, No. USNM-214249; 17.8 mm. 32. Paratype from same Institution No. USNM-214351; 19.0 mm. 33. Holotype of *Hindsia rewaensis* Ladd. Same Institution No. USNM-214335; 16.5 mm (after Ladd, 1982, pl.14, figs.20-22 and pl.11, figs.10,11).

Family TURRIDAE

Subfamily CLAVINAE Casey, 1904

Genus **Clavus** Montfort, 1810

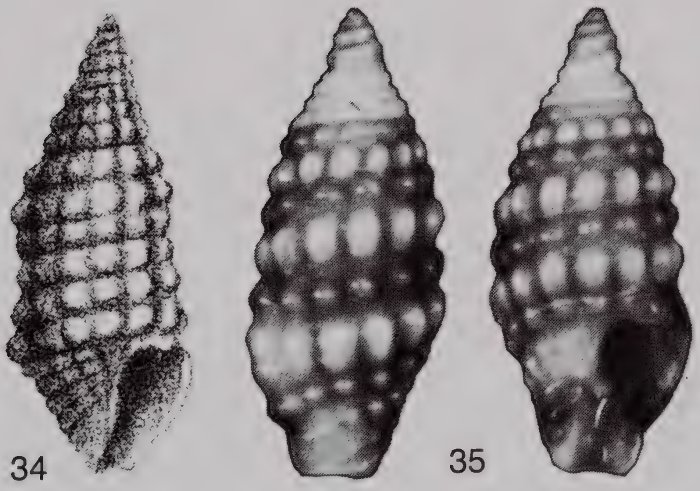
Clavus Montfort, 1810, Conch.Syst. 2:435. Type species by OD *C.flammulatus* Montfort, 1810. Recent, Indo-Pacific.

Clavus papillosus (Garrett, 1873) (Figs. 34,35)

1873. *Drillia papillosa* Garrett, Proc.Acad.Nat.Sci. Philadelphia Pt.2:218, pl.2, fig.29.

TYPE LOCALITY. Viti Isles (=Fiji Is).

Several specimens of the species have recently been collected at Moruroa Atoll, Tuamotu Archipelago, French Polynesia (*leg*. C.Beslu). This new record probably indicates that the species is wide-spread in the Pacific but is rarely collected because of its minute size. It is readily recognizable by its prominently nodulose sculpture. Some rows of nodules are smaller than others. The base colour is cream or pale gold with some rows of nodules being coloured brown, and some basal spiral cords are finely spotted with dark brown.



Figs. 34,35. *Clavus papillosus* (Garrett). 34. Type-figure; 6.0 mm (from Garrett, 1873, pl.2,fig.29). 35. Moruroa Atoll, Tuamotu Archipelago; 4.5 mm.

Acknowledgements. For the loan of type-specimens, photographs of types and exchange of information, I would like to express my thanks to Dr. P. Bouchet, Museum National d'Histoire Naturelle, Paris; Dr. R. Kilias, Zoological Museum, Humboldt University, Berlin; Mr C. Pettitt, University of Manchester museum; Dr. W.F. Ponder, Australian Museum, Sydney; Dr. R. Robertson, Academy of Natural Sciences, Philadelphia, and Dr. J. Taylor and Ms K. Way, British Museum (Natural History), london.

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TYPE SPECIMENS OF AMPHIBIANS, REPTILES, BIRDS AND MAMMALS IN THE AUCKLAND INSTITUTE AND MUSEUM

B.J. Gill

AUCKLAND INSTITUTE AND MUSEUM

Abstract. Included in the natural history collections of the Auckland Institute and Museum are type specimens pertaining to 34 species or subspecies of amphibians, reptiles, birds and mammals. In particular there are 26 name-bearing holotypes, lectotypes or neotypes. Details of these, and of plastotypes and paratypes, are given. The species involved are from mainland New Zealand, the Kermadec Islands, the Chatham Islands and from Heard and Kerguelen Islands in the subantarctic. Some are known only from fossils or subfossils. A lectotype of the skink *Leiolopisma smithi numerale* McCann, 1955 is nominated from among the syntypes.

Powell (1941, 1949) listed the species of amphibians and birds for which there were primary types in the collection of the Auckland Institute and Museum (AIM). The list is repeated here, and updated to include subsequent acquisitions of type material of reptiles, birds and mammals. Species are listed by their original names arranged alphabetically within each family. Where a name has since been synonymised this is indicated. Current (and former) catalogue numbers of the types are given. For holotypes, lectotypes, neotypes and plastotypes full details are provided of sex, locality, date of collection and collector where these are known. These details are the fullest account to be gleaned from the published descriptions, catalogue entries and any original labels.

Paratypes are problematical as the provisions of the International Code of Zoological Nomenclature (1961) regarding paratypes are unsatisfactory (see discussion by Melville 1970). Article 72(b) of the Code provides that every specimen cited in a description as belonging to a new species (except variants etc.) belongs also to the type-series of that species. Recommendation 73D suggests that all members of the type-series other than the holotype should be considered paratypes. No way of further restricting the number of paratypes is prescribed in the Code. This means that there is no agreed middle ground between ignoring paratypes altogether or accepting as paratypes nearly all specimens the author cited (the principle adhered to in this list). The latter causes various problems when the type-series is hard to delimit or very large. In this paper the total number of paratypes (or paralectotypes) established in the description of the species is given, followed by the number acquired by the Auckland Museum.

Rec. Auckland Inst. Mus. 20: 203-215 23 December 1983

CLASS AMPHIBIA

Family LEIOPELMATIDAE

(New Zealand Frogs)

Leiopelma archeyi Turbott, 1942

Trans. Proc. R. Soc. N.Z. 71: 248, Pl. 42.

Holotype: H43 (formerly AMPH 2.1); adult female; Tokatea, near Coromandel; date and collector not known.

Paratypes: 14 established. All deposited at AIM (H44-H57; formerly AMPH 2.2-2.15 respectively).

Notes: H51 is currently missing. H57 was given to the Museum of Comparative Zoology, Harvard in 1948.

CLASS REPTILIA

Family SCINCIDAE

(Skinks)

Leiolopisma alani Robb, 1970

Proc. Kon. Ned. Akad. Wet. C78: 477, Fig. 1, Pls. I, II.

Holotype: H560 (author's number R34); adult male; Green Island, Mercury group; July 1967; A. Thoresen.

Paratypes: 4 established. None at AIM.

Notes: Transferred to the genus *Cyclodina* by Hardy (1977).

Leiolopisma fallai McCann, 1955

Dom. Mus. Bull. 17: 87, Pl. X, Fig. 12.

Paratypes: 7 established. AIM has 4 (H510-H513; formerly REP 36.1-36.4; author's numbers S83-S86 respectively).

Leiolopisma gracilicorpus Hardy, 1977

N.Z. J. Zool. 4: 241, Fig. 7.

Holotype: H403 (formerly REP 31.1); Hokianga; presented Mr Webster before 1955.

Paratypes: None established.

Notes: A search of Museum records has yielded no further data on this specimen. The Mr Webster may have been John Webster (1818-1912) who first lived in the Hokianga area in 1841 and who joined the Auckland Institute in 1872. However, later Websters from Hokianga have given specimens to the Museum. McCann listed this specimen as a male in his hand-written notes.

Leiolopisma macgregori Robb, 1975

Proc. Kon. Ned. Akad. Wet. C78: 480, Fig. 1, Pls. I, II.

Holotype: H558 (author's number R72); adult female; Sail Rock, Bream Bay; May 1974; J. Robb.

Paratypes: 6 established. AIM has two (H559 and H614; author's numbers R3 and R73 respectively).

Notes: Transferred to the genus *Cyclodina* by Hardy (1977).

Leiolopisma pachysomaticum Robb, 1975

Proc. Kon. Ned. Akad. Wet. C78: 477 Fig. 1, Pls. I, II.

Holotype: H538 (author's number R67); adult female; Ruamahua-nui Island, Aldermen group; November 1972; A.H. Whitaker.

Paratypes: 9 established. AIM has 3 (H535-H537; formerly REP 40.1-40.3; author's numbers R48-R50 respectively).

Notes: Synonymised under *Cyclodina oliveri* (McCann, 1955) by Hardy (1977).

Leiolopisma smithi numerale McCann, 1955

Dom. Mus. Bull. 17: 99.

In the description of this subspecies McCann (1955) indicated that the type was among specimens in the Auckland Museum collected from Sladden Island by B. Sladden, January 1926. McCann listed other specimens from "Mercury Island" collected by Falla and also in the Auckland Museum. There are in the collection four specimens of this subspecies from Sladden Island and two from the Mercury Islands. All were examined by McCann, but neither the description, nor the specimen labels, nor McCann's hand-written notes on the specimens, indicate which is the holotype. I therefore take the opportunity here of nominating a Sladden Island specimen as lectotype, since this was not done by the last reviser (Hardy 1977). All specimens from both islands are conspecific and morphologically alike. I have chosen McCann's first-numbered specimen (S15) as lectotype.

Lectotype: H437 (formerly REP 34.1; author's number S15); male; Sladden Island, off Great Mercury Island; January 1926 (the catalogue gives 1920 as the date of collection); B. Sladden. Measurements: snout to vent length 65 mm, tail length 48 mm (tail twice regenerated), snout to forelimb length 25 mm, axilla to groin length 33 mm.

Paralectotypes: 5 established. All deposited at AIM (H438-H440; formerly REP 34.2-34.4; author's numbers S16-S18 respectively. H455-H456; formerly REP 34.22-34.23; author's numbers S65-S66 respectively).

Notes: H439 was given to the National Museum in 1952 and is numbered R565. This subspecies was not recognised in the revision by Hardy (1977).

Leiolopisma turbotti McCann, 1955

Dom. Mus. Bull. 17: 114, Fig. 13.

Holotype: H516 (formerly REP 37.1; author's number S142); female; The Pyramid, Chatham Islands; 16 December 1937; E.G. Turbott.

Paratypes: 13 established. AIM has one (H517; formerly REP 37.2; author's number S143).

Notes: Synonymised under *Leiolopisma nigriplantare nigriplantare* (Peters, 1873) by Hardy (1977).

Mocoa smithii Gray, 1845

Cat. Liz. Coll. Brit. Mus.: 82.

Paralectotypes: 38 established. AIM has one (H613; British Museum registration number 1946.8.17.29; "N. Zealand. Presented by the Admiralty, from the Antarctic Expedition.").

Notes: Now in the genus *Leiolopisma*. See McCann (1955) for lectotype designation. H613 was apparently collected in the Bay of Islands in 1841.

CLASS AVES

Family DINORNITHIDAE

(Moas)

Dinornis crassus Owen, 1846

Proc. Zool. Soc. Lond. for 1846: 46.

Plastotype: B722 (formerly AM 298, MOA 11.7 and British Museum registration number A.186); cast of left tarsometatarsus (subfossil) made at the British Museum 1938; original bone obtained from Waikouaiti by P. Earl (see Lydekker 1891).

Notes: Species accepted (in the genus *Emeus*) by Cracraft (1976).

Dinornis maximus Owen, 1869

Trans. Zool. Soc. Lond. 6: 497, Pls. 89, 90.

Plastotype: B724 (British Museum registration number A.161); casts of associated left femur, left tibiotarsus and right tarsometatarsus (subfossils) made at the British Museum 1938; original bones obtained August 1865 from Glenmark Swamp, Canterbury, by J. Michael (see Lydekker 1891).

Notes: Synonymised under *Dinornis giganteus* Owen, 1844 by Cracraft (1976).

Dinornis oweni Haast, 1885

Proc. Zool. Soc. Lond. for 1885: 482.

Lectotype: B721 (formerly AM 384 and MOA 9.9); subadult skull (subfossil) incorrectly reconstructed; Pataua, near Whangarei; 1878; T. F. Cheeseman.

Paralectotypes: None established. Millener (1982) showed that the postcranial elements of the skeleton described by von Haast (AM 384) belong to *Pachyornis mappini* Archey, 1941.

Notes: See Millener (1982) for lectotype designation. Synonymised under *Anomalopteryx didiformis* (Owen, 1844) by Millener (1982).

Dinornis torosus Hutton, 1891

N.Z. J. Sci. (new issue) 1: 248.

Lectotype: B723 (formerly AM 352 and MOA 7.3); almost complete skeleton (subfossil; mounted); Takaka, Nelson district; R.I. Kingsley.

Paralectotypes: One established; not at AIM.

Notes: See Archey (1941) for lectotype designation. Species accepted by Cracraft (1976).

Euryapteryx tane Oliver, 1949

Dom. Mus. Bull. 15: 105, Figs. 73-78.

Holotype: B725 (formerly AM 3 and MOA 15.1); almost complete skeleton (subfossil; unmounted); Paremata, Doubtless Bay; L.J. and G. Matthews.

Paratypes: The type-series is difficult to delimit; some other AIM specimens are referred to in the description.

Notes: Synonymised under *E. curtus* (Owen, 1846) by Cracraft (1976).

Megalapteryx benhami Archey, 1941

Bull. Auckland Inst. Mus. 1: 35.

Holotype: B718 (formerly AM 254 and MOA 14.1); subfossil femur; Mount Arthur tableland, Nelson district; probably collected 1933; G. Archey.

Paratypes: One established. Deposited at AIM (B719; formerly AM 254 and MOA 14.1; subfossil tibiotarsus).

Notes: Species tentatively accepted by Cracraft (1976).

Pachyornis mappini Archey, 1941

Bull. Auckland Inst. Mus. 1: 41, Figs. 9-11, Pls. 4, 5, 7, 9-12, 15.

Holotype: B720 (formerly AM 124 and MOA 8.32); almost complete skeleton (subfossil; mounted); Mangaotaki, Waitomo district; 1933; F.C. Mappin.

Paratypes: The type-series is difficult to delimit. In addition to the holotype, Archey (1941) referred about 14 specimens (most of them at AIM) to this species.

Notes: Species accepted by Cracraft (1976).

Pachyornis septentrionalis Oliver, 1949

Dom. Mus. Bull. 15: 61, Figs. 29-37.

Paratypes: About 11 specimens at AIM could probably be construed as belonging to the type-series of this species.

Notes: Synonymised under *P. mappini* Archey, 1941 by Cracraft (1976).

Family DIOMEDEIDAE

(Albatrosses)

Thalassarche cauta steadi Falla, 1933

Rec. Auckland Inst. Mus. 1:179, Pl. 32.

Holotype: AV 153.3; adult male; Foveaux Strait; December (November on label) 1931; E.F. Stead.

Paratypes: Falla referred to a female specimen but gave no repository. There is no such specimen at AIM.

Notes: Listed under *Diomedea cauta cauta* Gould, 1841 by Fleming (1953).

Family PROCELLARIIDAE

(Fulmars, Petrels & Shearwaters)

Oestrelata leucophrys Hutton, 1893

Proc. Zool. Soc. Lond. for 1893: 752, Pl. LXIII.

Holotype: AV 135.34 (formerly AV 215.1); in poor condition; Sunday Island, Kermadec group; 1889; T. Bell.

Paratypes: One established. Repository not stated.

Notes: Listed under *Pterodroma neglecta* (Schlegel, 1863) by Condon (1975).

Pachyptila belcheri orientalis Falla, 1937

B.A.N.Z.A.R.E. Rep. (B) 2: 200, Figs. 154, 174.

Paratypes: Almost the entire type-series of 22 specimens (including eggs) is at AIM.

Notes: The holotype is not currently at AIM, though it probably should be. The subspecies is not recognised in the current checklist (Kinsky 1970).

Pachyptila eatoni pyramidalis Fleming, 1939

Emu 38: 400.

Holotype: AV 1408.2 (formerly AV 209.52; author's number 325); adult male; Pyramid Rock, Chatham group; 16 December 1937; C.A. Fleming.

Paratypes: 10 established. None at AIM.

Notes: Treated as *P. crassirostris pyramidalis* Fleming, 1939 by Kinsky (1970).

Pachyptila salvini muriwai Mathews & Hallstrom, 1943

Notes Order Procell.: 23.

Lectotype: AV 146.17 (formerly AV 1386.2); female; Muriwai Beach, Auckland; 21 May 1934; R.A. Falla.

Paralectotypes: One established. Deposited at AIM (AV 146.16; formerly AV 1386.1).

Notes: See Fleming (1945) for lectotype designation. The race is not recognised in current checklists (Kinsky 1970, Condon 1975).

Pachyptila turtur fallai Oliver, 1930

N.Z. Birds 1st ed.: 114.

Holotype: AV 209.22 (formerly AV 213.1); immature male; Otago; W. Smyth; probably purchased from Smyth 1886 or 1887.

Paratypes: 2 established. Repositories not stated.

Notes: The race needs confirmation (Kinsky 1970).

Pseudoprion turtur armiger Mathews & Hallstrom, 1943

Notes Order Procell.: 23.

Neotype: AV 209.54 (previously F.715); adult male; Aorangi Island, Poor Knights group; December 1940.

Notes: See Fleming (1945) for neotype designation. The species is now in *Pachyptila* and the race needs confirmation (Kinsky 1970).

Pterodroma pycrofti Falla, 1933

Rec. Auckland Inst. Mus. 1: 176, Pl. 31.

Holotype: AV 200.2 (formerly AV 148.5); adult male; Taranga (Hen Island); 27 January 1932; R.A. Falla.

Paratypes: 2 established. Both at AIM (AV 200.1, AV 200.3).

Notes: The species is recognised in the New Zealand checklist (Kinsky 1970) but synonymised under *Pterodroma cookii* (Gray, 1843) in the Australian checklist (Condon 1975).

Puffinus assimilis haurakiensis Fleming & Serventy, 1943

Emu 43: 119.

Holotype: AV 130.9; adult male; Lizard Island, Mokohinau group; 4 October 1933; R.A. Falla.

Paratypes: The type-series of at least 17 specimens cannot easily be delimited as no repositories are given.

Notes: The race is recognised in the current checklist (Kinsky 1970).

Family HYDROBATIDAE

(Storm Petrels)

Oceanites oceanicus parvus Falla, 1937

B.A.N.Z.A.R.E. Rep. (B) 2: 208.

Holotype: AV 1202.8 (BANZARE number 1073); male; Royal Sound, Kerguelen Island; 10 February 1930; R.A. Falla.

Paratypes: 6 established. Three at AIM (B3722, AV 1202.9 and AV 1202.10; BANZARE numbers 818, 1074 and 1075 respectively).

Notes: The race is doubtfully distinct (Condon 1975).

Family PELECANIDAE

(Pelicans)

Pelecanus conspicillatus novaezealandiae Scarlett, 1966

Notornis 13: 204, Figs. 1-11.

Paratypes: 5 established. One at AIM (subfossil bones; not numbered).

Notes: The AIM paratype is currently missing.

Family PHALACROCORACIDAE

(Shags)

Phalacrocorax atriceps nivalis Falla, 1937

B.A.N.Z.A.R.E. Rep. (B) 2: 226, Figs. 182, 183, 185.

Holotype: AV 1398.1 (BANZARE number 460); female; Atlas Cove (Corinthian Bay on label), Heard Island; 29 November 1929; R.A. Falla.

Paratypes: 2 established. Both at AIM (AV 1398.2 and AV 1398.3; BANZARE numbers 458 and 459 respectively).

Family RALLIDAE

(Rails)

Capellirallus karamu Falla, 1954

Rec. Auckland Inst. Mus. 4: 242, Pls. 40-42.

Holotype: B7 (formerly AV 901.1); incomplete subfossil skeleton; Karamu Cave, near Pirongia; 1948; H.G. Lambert.

Paratypes: Several established. None at AIM.

Family SCOLOPACIDAE

(Curlews, Snipes, etc.)

Coenocorypha aucklandica barrierensis Oliver, 1955

N.Z. Birds 2nd ed.: 275.

Holotype: AV 1389.1 (formerly 186 and AV 78.2); Little Barrier Island; 1870; Captain Bennett (presented T.B. Hill).

Paratypes: None established.

Notes: The race is not mentioned in the current checklist (Kinsky 1970), but see discussion by Turbott (1961).

Family AEGOTHELIDAE

(Owlet-nightjars)

Megaegotheles novaezealandiae Scarlett, 1968

Notornis 15: 254, Pls. XL-XLII.

Paratypes: 34 established. AIM has one (B341; subfossil bones).

Family MELIPHAGIDAE

(Honeyeaters)

Anthornis melanura obscura Falla, 1948

Rec. Auckland Inst. Mus. 3: 337.

Holotype: AV 15.22; adult male; Three Kings Islands; 20 February 1934; R.A. Falla.

Paratypes: 2 established. Both at AIM (AV 15.23 and AV 15.24; mounted).

Notes: The race is accepted in the current checklist (Kinsky 1970). The type locality is Great Island since the 1934 expedition landed only on that island (Turbott & Buddle 1948).

CLASS MAMMALIA

Family OTARIIDAE

(Sealions & Fur Seals)

Neophoca palatina King, 1983

N.Z. J. Mar. Freshwater Res. 17: 120, Figs. 1, 4, 7, 9.

Holotype: MAM 175.1; adult male skull (fossil); Ohope Beach, Bay of Plenty; pres. C. McCready 1939.

Paratypes: None established.

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INTERACTION BETWEEN AN ICHNEUMONID WASP AND THE AUSTRALIAN TONGUE ORCHID IN NEW ZEALAND

D.K.F. GRAHAM

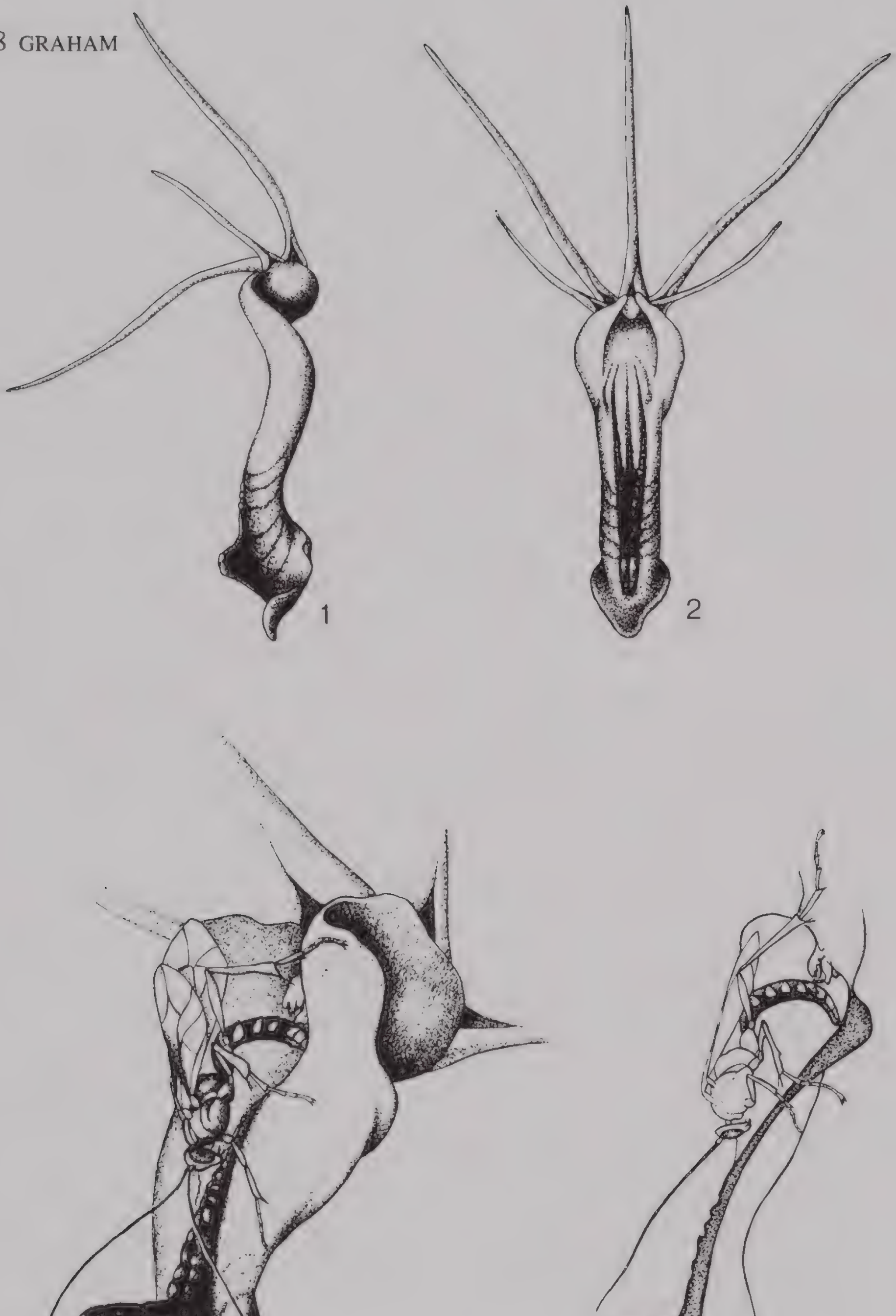
Abstract. Plants of *Cryptostylis subulata* taken from the recently discovered colony in North Auckland were observed during flowering over seven weeks. The only potential pollinators seen in daytime were males of *Lissopimpla excelsa*, a parasitic wasp species long known in many parts of New Zealand. Following pseudocopulation with a flower (as in Australia) the insect carried away waxy pollinia. Most open flowers were visited, often several times, pollinia were removed from 33, but only six capsules matured. Simple experiments indicated that scent was the primary attractant, bringing wasps to newly exposed flowers within 1-2 minutes.

In reporting the discovery at Motutangi Swamp, North Auckland, of the Australian tongue orchid *(Cryptostylis subulata* (Labill.) Reichenb.) Graham (1976) commented "In Australia the flowers of several species of *Cryptostylis* are reputed to mimic the female of an ichneumon wasp *(Lissopimpla semipunctata);* certainly they attract the male wasps which effect pollination. This poses fascinating questions about pollinators and pollination in New Zealand where related wasps occur." Attempts to find answers are reported here.

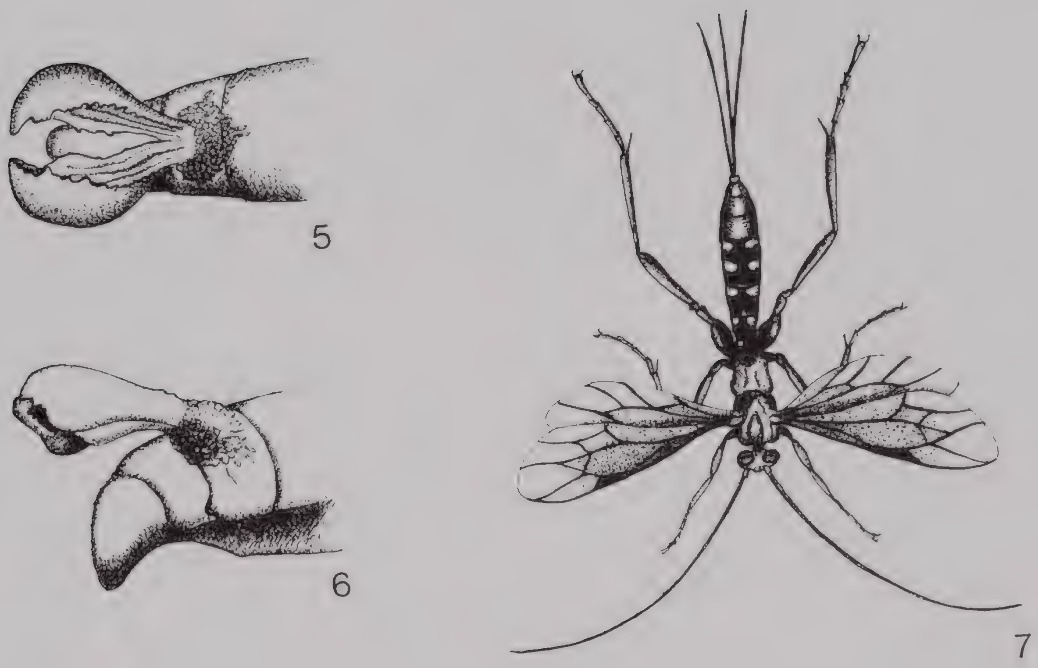
In New Zealand *Lissopimpla excelsa* Costa (=*L.semipunctata* Kirby) [Hymenoptera: Ichneumonidae] is widespread and well known as a parasite of certain subterranean caterpillars. This is the same species that has been often reported to be involved in Australia in sexually conditioned pollination or pseudocopulation with various orchids of the genus *Cryptostylis*. Coleman (1928), following her first report (Coleman 1927), wrote ". . . so, with a Machiavellian cunning almost beyond belief, the orchid lures the artless insect to its service."

The *Cryptostylis* flower has a large reddish labellum *c*.23 mm in length, and long narrow greenish petals and sepals (Figs.1,2); the column, which is described and illustrated by Dockrill (1969), is only 3 mm long, with wings projecting a little above the anther margins, and a very prominent stigma bearing a rounded rostellum. The two-celled anther, standing above the stigma, contains four pollinia, in two lamellate pairs, members of a pair unequal, and all attached directly to a single hemispherical disc. In *C. subulata* flowers are well spaced in a long raceme.

Field observations at Motutangi Swamp (mostly during afternoons) failed to reveal any pollinators though many of the orchid plants bore new and ripening seed capsules. Plants were therefore taken in January 1978 to Whangarei, about 150 km from the only occurrence then known in New Zealand, and five were established in a pot in a garden. The site was open, receiving the sun most of the day and sheltered only from southerly winds. On the hillside below, native forest and manuka *(Leptospermum)* covered a large area, and sections on either side were mostly covered in rank grass. Detailed observations,



Figs. 1-4. 1,2. Flower of *Cryptostylis subulata*. 1. Side. 2. Front. Length of labellum: *c*. 23 mm. 3. Characteristic position of male wasp *(Lissopimpla excelsa)* on flower of tongue orchid *(Cryptostylis subulata)* during pseudocopulation. 4. Orchid flower with part of labellum removed to show position of pollinia in relation to tip of wasp abdomen.



Figs. 5-7. 5,6. Pollinia attached to wasp abdomen. 5. Dorsal. 6. Lateral. 7. *Lissopimpla excelsa*, female. Length, head to end of ovipositor: *c*. 22mm.

restricted mainly to weekends, continued from late March to mid May. Male ichneumon wasps visiting the flowers were identified by Dr R.P. Macfarlane as *Lissopimpla excelsa* and specimens were deposited in the National Insect Collection at the Mount Albert Research Centre, Auckland. A wasp bearing pollinia firmly attached to the abdomen has been placed in the Auckland Museum, together with colour transparencies of flowers of the tongue orchid.

Observations

Towards the end of March the five plants began to flower and immediately male wasps were attracted. On the morning of 26 March one was seen to fly directly to a flower and attempt to copulate with it. Pale pollinia, 2 mm long, became attached to the wasp's dark abdomen and were easily seen with the naked eye. Between 9.40 a.m. and 3.25 p.m. on that day 13 wasps visited the orchid flowers and at one time five were present.

During the whole period of observation (entirely in daylight hours) no other pollinator was seen, nor were any female wasps detected in the vicinity. Most wasp activity occurred between 8.30 a.m. and noon, after which visits decreased, the latest recorded arrival being at 4.11 p.m. Invariably the number of wasps present was greatest during warm sunny conditions with an accompanying light breeze, and most wasps approached from areas downwind of the orchids.

The wasp usually flies directly to the flower, alighting on the convex surface of the labellum and facing towards the protruding horn near the apex. It then backs rapidly, inserting the tip of its abdomen into the centre of the flower and grasping the outer edges of the labellum with its two long hind legs (Figs.3,4). In this way the end of the abdomen comes in contact with the column, and the viscid disc at the base of the pollinia immediately adheres to it. The abdomen appears to remain almost still but the antennae and wings can move considerably during part or throughout the whole of the pseudocopulation which lasts up to 90 seconds though the average duration is 8 seconds. Out of 40 approaches observed, only five were indirect; twice a wasp alighted on the back of the labellum and three times the head was towards the base of the labellum. All five quickly established the correct position.

The first wasp to visit a recently-opened flower usually detaches itself with the bright yellow pollen masses, of the pollinia glued to the dorsal surface of the abdomen (Figs.5,6), presumably in position for touching the stigma of the next flower. The wasp may fly off to another flower, or it may re-enter the same one, repeating pseudocopulation up to 19 times before leaving. A wasp visiting a series of fresh flowers can become festooned with the pollinia from four or five flowers, without any apparent effect on its flying ability. On two occasions when only one fresh flower was available the wasp that removed the pollinia returned after an hour's absence with pollinia still attached. Very rarely were as many as three flowers open at a time on any one stem and it was not uncommon, when numerous wasps were present, to see two or even up to five of various sizes 'copulating' simultaneously with one flower. Flowers from which pollinia had not been taken lasted 14 to 16 days, in observed cases. A flower without its pollinia may be visited by wasps for some hours but its attractiveness soon diminishes. There was no evidence of feeding or of deliberately gathering pollen.

The five plants bore a total of 73 flowers, of which 33 had the pollinia removed by wasps, but only six capsules developed. Fertilisation was achieved only in flowers near the base of each raceme, namely the first, third and fourth out of 14, the first and third out of 20, and the fifth out of 14.

Experiments

The strong attraction that the fresh orchid flower exerts on the male ichneumon wasp appears to be due to an odour that human senses do not perceive. Two simple experiments confirmed that scent is the primary attractant.

First, the plants were moved indoors so that flowers opened away from wasps. After five days the plants, now bearing fresh flowers, were placed outside again. Within 45 seconds the first wasp arrived, and after two minutes five were in attendance; all came from downwind of the orchids, suggesting a strong scent attractant.

Subsequently, the orchids were taken indoors for a further five days, then placed outside again, this time with the entire plant covered with a fine muslin cloth. The results were much the same, with the first wasp coming 73 seconds after the shrouded plants were put out. This wasp flew almost directly to the base of the covering and gained immediate access to the flowers. All the seven other wasps that were seen to arrive were able to reach the hidden flowers without too much searching. In two other sites to which the orchids were transferred similar trials gave comparable results.

Discussion

Modern work on chemical attractants in pollination is reviewed by Faegri & van der Pijl (1966) and by Proctor & Yeo (1973) who also refer to visual and tactile stimuli. The phenomenon of pseudocopulation in which male insects perform at least part of the mating behaviour in response to orchid flowers has long been known (Correvon & Pouyanne 1916) and the relationship between species of *Lissopimpla* and of *Cryptostylis* in Australia is extensively documented (Coleman 1927-1938; Froggatt 1927; Godfrey 1929; Leonard 1970; Stoutamire 1974, 1975; Bates 1977; Wallace 1978).

The flower of *Cryptostylis subulata* resembles the female *Lissopimpla* wasp in certain superficial respects, perhaps sufficiently to orient the male wasp into the correct position to pick up the pollinia. By comparing the female wasp (Fig.7) with the anterior view of the flower (Fig.2) some similarities can be recognized. The two outer calloused ridges and the dark central line that traverses most of the length of the labellum, with their highly polished surfaces, could simulate the pattern of white dots down the sides of the female's abdomen, and also closely parallel the tactile quality of the wasp's body. The silhouette created by these three dark lines has a vague approximation to the abdomen with ovipositor and the long hind legs of the female. The fine but distinct veining that extends out horizontally from the central ridge and down the tightly reflexed mid section of the labellum may enhance the overall resemblance. Visual or tactile stimuli may play a part but it was noticed that flowers, though otherwise unchanged, seemed to lose their attractiveness soon after pollinia had been removed.

The observations now reported show that the male wasps of *L. excelsa* are immediately attracted by scent to flowers of the tongue orchid, a plant with which, in New Zealand, they can have had no previous experience. The numbers of wasps competing (on most days) for the available flowers ensured that nearly all open flowers would be visited at least once but fewer than ten per cent developed into capsules. The wasps carried away pollinia, sometimes collecting several sets from different flowers, but deposition of pollen on stigmas was not observed. The waxy pollinia appeared to remain intact on the insects' bodies, but gradual attrition might perhaps have occurred, with granules being left on stigmas (compare Darwin 1877).

The *Cryptostylis*/*Lissopimpla* example is often quoted in discussions of the important reciprocating evolutionary processes underlying plant/animal interactions but such theoretical considerations lie outside the scope of this paper.

Acknowledgements. The author expresses thanks to L.B. Moore, R.P. Macfarlane, and E.W. Valentine for constructive help; also to Mr and Mrs R. Seymour for continuing interest and assistance, and to Susan Graham who succeeded in capturing the female wasp depicted.

[Digby Graham died on 18 March 1979. In the previous October the draft of his paper was considered by L.B.M., R.P.M., and E.W.V. The present version, belatedly edited by L.B.M., incorporates information added in response to queries arising from his first draft. In the list of References those marked *, considered by an anonymous referee to be important, were not mentioned in the original text; most are brief and some later ones were not available to the author during his study. Stoutamire (1974, 1975) presented evidence of self-incompatibility in *Cryptostylis*, and Wallace (1978) noted that the flowering of *Cryptostylis* coincides with the activity of male *Lissopimpla* which emerge from pupation some time before the females.]

[The Seymours have sighted and photographed Ichneumonid wasps pseudocopulating with Australian tongue orchid flowers *in situ* at Motutangi Swamp during the mornings (but not the afternoons) of 5, 6 November 1983. — Editor]

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TRANS-OCEANIC INSECT DISPERSAL

1. Trapping and collecting on ships in the South Pacific Ocean, 1974-1979

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Abstract. An introduction to this series mainly covers the Bernice P. Bishop Museum, Honolulu, projects on arthropod dispersal, 1957-1970. Continuation of these studies from the Auckland Museum started with collecting on ships at sea since 1965 and ship-board trapping in the South Pacific area in 1969.

Part 1 of the series records net-trapping on ships during regular return voyages from New Zealand through Fiji, Samoa and Tonga in the South Pacific Ocean. Trapping and collecting on 29 voyages between 1974 and 1979 are reported. Tables and maps of successful net runs and collections are included. Voyages are compared and preliminary insect and other arthropod results noted.

In the late 1950s and early 1960s, the late J. Linsley Gressitt, of Entomology Department, Bernice P. Bishop Museum, Honolulu, began investigating wind-borne insects by trapping on ships and with aircraft in the Pacific Ocean and Antarctic areas. Subsequently, trapping was also done on ships in the Atlantic and Indian Oceans and on land in Antarctica, on subantarctic islands and in northern Alaska as part of trans-oceanic arthropod dispersal studies.

Antarctic and subantarctic trapping so far reported continued until 1966 and in the Pacific and other areas until 1970.

Results of trapping and collecting on ships in the Pacific area, 1957-1970, have been recorded in a numbered series of papers by Gressitt & Nakata (1958), Yoshimoto & Gressitt (1959, 1960, 1961), Harrell & Yoshimoto (1964), Harrell & Holzapfel (1966), Holzapfel & Perkins (1969), Guilmette, Holzapfel & Tsuda (1970) and Holzapfel, Clagg & Goff (1978). All these records were for the North Pacific area except for a few collections made on two ship passages which included Samoa (Holzapfel & Perkins (1969), Society Is and further south, and the Galapagos Is (Holzapfel, Clagg & Goff 1978). Concurrent trapping for smaller organisms, which produced some arthropod specimens, was also done on three voyages between 1967 and 1970 (Kramer, Wartell & Holzapfel 1973).

Trapping results from two other ship expeditions were also reported per the Bishop Museum project. During the round-the-world 'Galathea' Expedition, 1950-1952 (Yoshimoto, Gressitt & Wolff 1962), successful trapping had been done throughout the whole cruise including catches around New Zealand and in the South and North Pacific. Catches were also made in the North Pacific, South Pacific and in the New Zealand area during the 'Monsoon' Expedition, 1960-1961 (Gressitt, Coatsworth & Yoshimoto 1962).

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Two numbered papers on trapping in the Pacific-Antarctic area (Yoshimoto, Gressitt & Mitchell 1962, Yoshimoto & Gressitt 1963) included results from ship-board trapping on North and South Pacific voyages and south of New Zealand. The first of three papers on trapping in the Antarctic area (Gressitt, Leech & O'Brien 1960) gave results from ship-board trapping between New Zealand and Antarctica and around the continent to South America in the 1959-60 Antarctic summer season. Net trapping was also done with small aircraft and on the ground in the Ross Sea sector of Antarctica in the same season. A second paper (Gressitt, Leech, Leech, Sedlacek & Wise 1961) recorded net trapping in the 1960-61 season on ships south of Australia, New Zealand and South America and on land in the Ross Sea and Antarctic Peninsula sectors.

During the course of a separate project by Madison E. Pryor, of University of Tennessee, U.S.A., trapping for air-borne arthropods on land in the Ross Sea sector of Antarctica had also been done in the 1959-60 season (Pryor 1962).

Further trapping on ships and on land in Antarctica between the 1959-60 and 1961-62 seasons was noted by Gressitt, Leech & Wise (1963).

Dispersal studies for the Bishop Museum project were extended to the Atlantic area in 1962 by ship-board trapping on a United States Antarctic survey ship (Holzapfel, Tsuda & Harrell 1970) and on British Antarctic Survey ships from 1962 to 1965 (Clagg 1966).

A third paper on trapping in Antarctica (Holzapfel, Tsuda & Harrell 1970) contained results of ship-board trapping on many voyages south of New Zealand and South America from 1963 to 1966 and also on Atlantic, South Pacific and Indian Ocean voyages from 1962 to 1965.

Net trapping on land in relation to trans-oceanic dispersal was also carried out on two subantarctic islands, Campbell I, 1961-62 (Gressitt 1964b) and South Georgia, 1962-64 (Gressitt 1970).

Further dispersal studies by net trapping were made north of the Arctic Circle in northern Alaska in the Arctic summers of 1966 and 1969 (Gressitt & Yoshimoto 1974).

A high speed trap developed for use on large aircraft was first used in the 1960-61 Antarctic season (Gressitt, Sedlacek, Wise & Yoshimoto 1961) on flights between Antarctica and the east coast of the United States, via New Zealand and Honolulu, and subsequently over the North Pacific Ocean. Results of flights, including North America/Antarctica and also North Pacific flights, from 1960 to 1963, were reported by Holzapfel & Gressitt (1965). Final results covering use of this trap over the North Pacific Ocean and the United States from 1966 to 1969 were given by Holzapfel (1978). Concurrent trapping for smaller organisms was also done with this trap in 1968-69 (Kramer & Holzapfel 1973).

An overall discussion on Bishop Museum trans-oceanic dispersal studies in the 1957-1966 period was published by Holzapfel & Harrell (1968).

The dispersal studies and results have supplied more data towards the understanding of trans-oceanic arthropod movement and distribution. J.L. Gressitt assessed the information in many biogeographical discussion papers (Gressitt 1961, Gressitt & Yoshimoto 1963, Gressitt 1964, 1965a, 1965b, 1967, 1970, 1974).

Identifications of some of the arthropod specimens trapped and collected during the Bishop Museum dispersal studies have been recorded and discussed separately (Thornton 1964, Yoshimoto & Gressitt 1964, Thornton & Harrell 1965, Yoshimoto & Gressitt 1965, Scudder 1968, Forster 1971, Zimmerman 1975). In a summary to the Insects of Campbell Island Monograph, Gressitt (1964b) listed identified species of insects taken in net traps on Campbell I, but only a few of these are recorded as such in the taxonomic papers in the Monograph.

From 1965, when the present author took up his current position in the Auckland Museum, his interest in insect dispersal was continued with the assistance of a keen bird-watcher, J.A.F. Jenkins, who was then a deck officer on ships sailing from New Zealand ports. Jenkins collected insects for the Auckland Museum at various overseas ports on western routes to Australia and India and in the Pacific Islands while also, by request, watching for, collecting and recording insects at sea.

In 1969, net trapping was done for the author during the Royal Society of New Zealand Cook Bicentenary Expedition in the South Pacific, 1969, and the results of trapping and collecting on *HMS Endeavour* were recorded (Wise 1971).

However, all the collecting on ships at sea had been sporadic, using ships on various routes at various times just as and when they became available and when passage for collectors could be obtained. Consequently, in 1974, when Jenkins (now Captain) offered to start net trapping as often as possible on regular shipping runs in the South Pacific he presented an opportunity for comparable sampling over a longer period. Further, the route to and from the Pacific Islands was northerly and southerly, as well as being amongst some of the island groups, giving an opportunity to test the effect of easterly tradewinds in the tropics against the general west-east drift.

Information presented here is the result of trapping and collecting on ships at sea during 29 voyages in the period 1974-1979.

SOUTH PACIFIC OCEAN, 1974-1979

METHODS

Union Shipping Company voyages are numbered for each vessel and these voyage numbers are used here. Captains are in command of vessels for several voyages at a time then are replaced for several, hence the intermittent voyage numbers which appear in the records. Captain Jenkins flew nets on most of his voyages and consecutive sample numbers were used through each group of voyages. The voyages were made on regular triangular courses, as indicated in Fig. 1, beginning and ending at Auckland, New Zealand, and proceeding through Fiji, Samoa and Tonga.

The voyages reported on here are listed in Table 1, together with numbers of net runs, net samples, net runs with specimens, collected specimens and some percentages. It is seen that a large number of net runs were made and large numbers of samples taken (92.87% in all). Of these a little less than half contained arthropod specimens (43.51% of net runs, 46.85% of net samples).

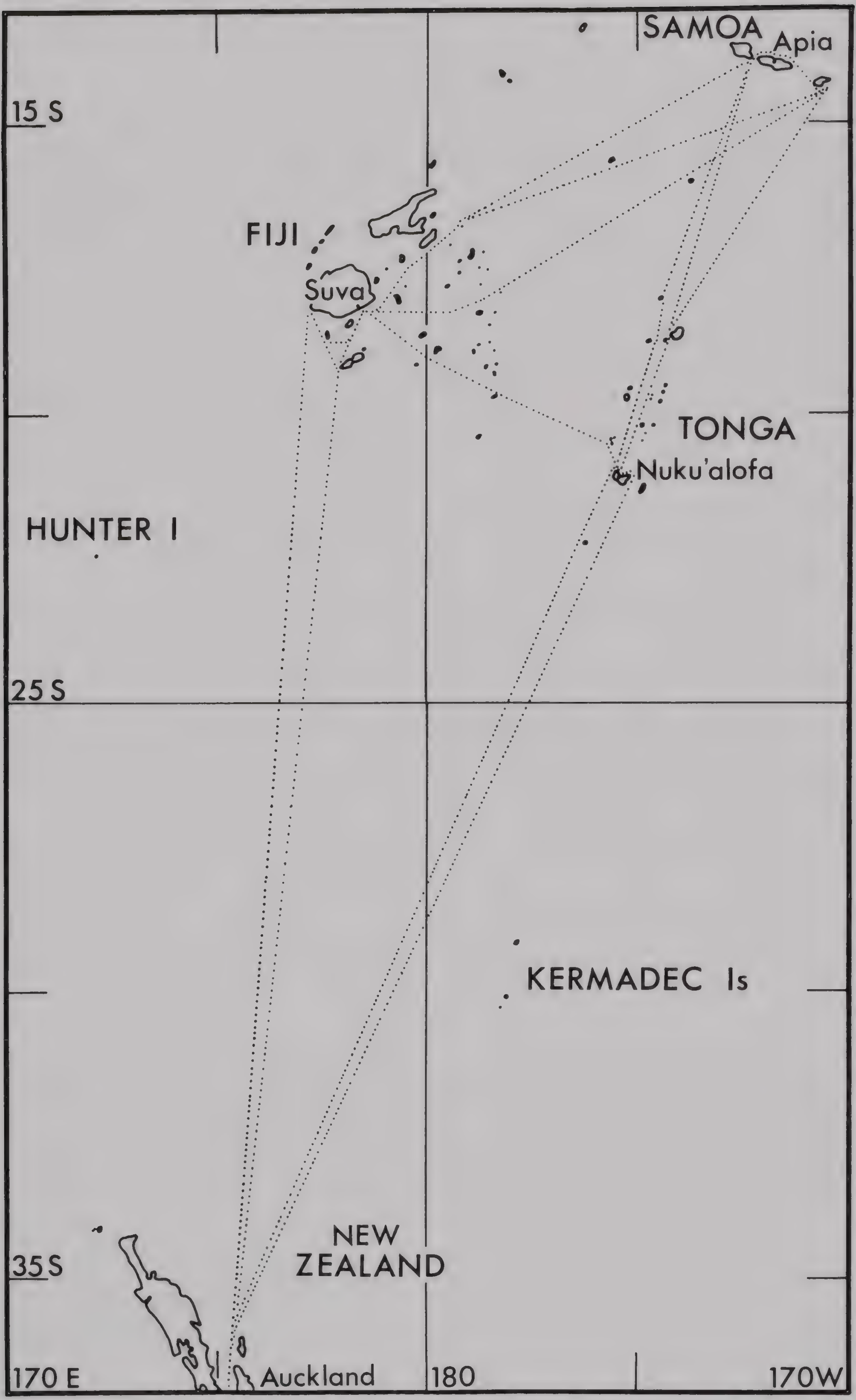


Fig. 1. Routes of ships on Pacific Islands voyages.

Table 1. Net runs, samples and collections on *Union South Pacific* and *Marama* voyages, 1974-1979.

Years	Voyages	No of net runs	Numbered net samples	% net runs with samples	No of net runs with specimens	% net runs with specimens	% samples with specimens	Numbered hand collections	Unnumbered hand collections	Total hand collections
1974	USP 19	22	8	36.36	6	27.27	75.00	2	1	3
	USP 20	12	4	33.33	2	16.66	50.00		1	1
	USP 28	23	23	100.00	12	52.17	52.17	1		1
	USP 31	20	19	95.00	11	55.00	57.89	7		7
1974-1975	USP 32	20	21 †	100.00	13	65.00	61.90	2		2
1975	USP 35	16	14	87.50	5	31.25	35.71			
	USP 36	13	12	92.30	3	23.07	25.00			
	USP 39	18	17	94.44	8	44.44	47.05	2		2
	USP 40	16	16	100.00	7	43.75	43.75		1	1
1978	M 1	18	18	100.00	11	61.11	61.11		2	2
	M 4	9	9	100.00	3	33.33	33.33	1		1
	M 5	4	4	100.00	1	25.00	25.00			
	M 6	14	14	100.00	9	64.28	64.28		2	2
	M 10	15	15	100.00	3	20.00	20.00			
	M 11	15	15	100.00	7	46.66	46.66			
	M 12	13	13	100.00	3	23.07	23.07			
	M 13	6	5	83.33	2	33.33	40.00			
	M 15‡								1	1
	M 17‡								1	1
1978-1979	M 24	17	17	100.00	9	52.94	52.94			
1979	M 25	19	19	100.00	13	68.42	68.42			
	M 30	11	11	100.00	10	90.90	90.90			
	M 31	14	14	100.00	6	42.85	42.85			
	M 32	4	3	75.00	2	50.00	66.66			
	M 37	11	11	100.00	4	36.36	36.36			
	M 38	16	16	100.00	6	37.50	37.50		1	1
	M 42	24	24	100.00	11	45.83	45.83			
	M 43	4	4	100.00	1	25.00	25.00			
	M 46	19	19	100.00	3	15.78	15.78		1	1
Totals	29	393	365		171			15	11	26
% of totals				92.87		43.51	46.85			

† Two numbered samples were taken from one net run ‡ Collections made for J. A. F. Jenkins who was not on board for these voyages

The nets used were similar to those used previously (Yoshimoto & Gressitt 1960, Wise 1971), being fine fabric cones on steel rings 75 cm in diameter; usually flown four or more at a time. Sample numbers were given when samples were taken from nets but collected specimens were sometimes numbered and sometimes not.

In the Museum all samples have been sorted under a microscope and those containing arthropod material stored in alcohol, except for the occasional large insect, such as a moth, which was pinned. Printed labels indicating ship, voyage and sample have been added together with other relevant data.

The data presented here in tables (Tables 2-30) and maps (Figs. 2-25) only include information concerning successful net runs (that is, when the samples taken were found to contain arthropod material) and hand collected specimens. Data presentation in tables is in much the same format as in all previous papers. However, it is considered worthwhile to include here maps for all the voyages in the present series to show the extent of successful net runs and collections, and the recurring mid-oceanic catches. The maps will also enable comparison of catch runs voyage by voyage and month by month and, in due course, of occurrences of various families or species of Arthropods.

As identification of all insect and other arthropod material is still in progress, the specimen records are given here only in general terms. It is intended to present information on species and possible sources of specimens in later parts of this series.

RESULTS

In the first year of the series, 1974, samples were taken during net trapping on five voyages of the *Union South Pacific* (*USP* 19, 20, 28, 31, 32 [part], Tables 2-6, Figs. 2-6). Many successful net runs were made, mostly near New Zealand and amongst the Pacific Islands.

There were five *Union South Pacific* voyages when samples were taken in 1975 (*USP* 32 [part] 35, 36, 39, 40, Tables 6-10, Figs. 6-10), but USP 32 samples were negative. Most successful net runs were amongst the Pacific Islands but there were also some mid-oceanic catches.

No net trapping was done in 1976 and 1977.

Trapping was resumed on the ship *Marama* in 1978, when samples were taken on nine voyages (*M* 1, 4, 5, 6, 10, 11, 12, 13, 24 [part], Tables 11-18, 21, Figs. 11-16, 18). Successful net runs were again mostly amongst the Pacific Islands but several were mid-oceanic and some near New Zealand.

Finally, in 1979, there were ten successful voyages for samples on the *Marama* (*M* 24 [part], 25, 30, 31, 32, 37, 38, 42, 43, 46, Tables 21-30, Figs. 18-25). Most of the successful net runs were mid-oceanic and amongst the Pacific Islands.

Monthly comparisons

Over the whole period, samples with specimens were taken in each month except November, indicating wind dispersal during the mid-year southern winter, as well as in the summer.

For comparison, the voyages are here listed for the months in which they were made.

January	*M* 1 (Table 11, Fig. 11), *M* 24 [part] (Table 21, Fig. 18), *M* 25 (Table 22, Fig. 19).
February	*USP* 35 [part] (Table 7, Fig. 7).
March	*USP* 35 [part] (Table 7, Fig. 7), *USP* 36 (Table 8, Fig. 8), *M* 4 (Table 12, Fig. 12), *M* 5 (Table 13, Fig. 12), *M* 6 [part] (Table 14, Fig. 13).
April	*M* 6 [part] (Table 14, Fig. 13), *M* 30 (Table 23, Fig. 20), *M* 31 [part] (Table 24, Fig. 21).
May	*USP* 19 (Table 2, Fig. 2), *USP* 20 (Table 3, Fig. 3), *USP* 39 (Table 9, Fig. 9), *USP* 40 (Table 10, Fig. 10), *M* 31 [part] (Table 24, Fig. 21), *M* 32 (Table 25, Fig. 21).
June	*M* 10 (Table 15, Fig. 14), *M* 11 (Table 16, Fig. 15).
July	*M* 12 (Table 17, Fig. 16), *M* 13 (Table 18, Fig 16), *M* 37 (Table 26, Fig. 22).
August	*M* 15 (Table 19, Fig. 17), *M* 38 (Table 27, Fig. 23).
September	*M* 17 (Table 20, Fig. 17), *M* 42 [part] (Table 28, Fig. 24).
October	*USP* 28 (Table 4, Fig. 4), *M* 42 [part] (Table 28, Fig. 24), *M* 43 (Table 29, Fig. 24).
November	Nil.
December	*USP* 31 (Table 5, Fig. 5), *USP* 32 (Table 6, Fig. 6), *M* 24 [part] (Table 21, Fig. 18), *M* 46 (Table 30, Fig. 25).

ARTHROPOD DISPERSAL

The samples with specimens and the hand collections are recorded below in several categories. These categories have been arbitrarily chosen to give some indication of the importance of the arthropod specimens in regard to trans-oceanic dispersal.

Net trapped mid-ocean

The whole net run was 45 n.ml. or more from land.

USP 19: 1. *USP* 20: B, D. *USP* 28: 2, 17, 20. *USP* 31: 1, 2, 5, 7, 25. *USP* 32: 27, 28, 30. *USP* 35: 8A. *USP* 36: 18. *USP* 39: 1, 17. *USP* 40: 19, 21, 23, 29, 31. *M* 1: 1, 2, 3, 4, 8. *M* 6: 15, 16, 17, 18, 25. *M* 13: 44. *M* 24: 1, 3, 5, 15. *M* 25: 19, 31, 34, 35. *M* 30: 1, 2, 3, 4, 5, 6, 9. *M* 31: 13, 14, 15, 24. *M* 37: 1, 3, 8. *M* 38: 12, 13, 14, 16, 25, 26. *M* 42: 1, 4, 5, 7, 21, 22. *M* 43: 25. *M* 46: 16.

Net trapped at sea/off shore (Pacific Islands)

One end of the net run was within 45 n.ml. of the shore of one or more of the islands, or the whole run was amongst Pacific Islands.

USP 19: 2, 5, 6, 7, 8. *USP* 28: 6, 7, 10, 11, 12, 13, 14, 16. *USP* 31: 8, 10, 13, 17, 18. *USP* 32: 34, 35, 36, 37, 38, 39, 44. *USP* 35: 5, 6, 7, 8. *USP* 36: 19, 20. *USP* 39: 5, 9, 10, 11, 12, 13. *USP* 40: 25, 28. *M* 1: 6, 7, 10, 12. *M* 4: 1, 3, 4. *M* 6: 23, 24, 29, 31. *M* 10: 6, 10, 11. *M* 11: 18, 19, 21, 22, 23, 24, 25. *M* 12: 38, 39, 40. *M* 13: 48. *M* 24: 6, 8, 10, 12. *M* 25: 24, 25, 26, 27, 28, 29, 30. *M* 30: 7, 8, 10. *M* 31: 20, 23. *M* 32: 26, 27. *M* 37: 5. *M* 42: 10, 12, 18, 19, 20. *M* 46: 9, 14.

Net trapped at sea/off shore (New Zealand)

One end of the net run was within 45 n.ml. of the New Zealand coast and off shore islands.

USP 28: 23. *USP* 32: 26. *M* 1: 18. *M* 5: 10. *M* 24: 17. *M* 25: 18, 36.

Net trapped in harbour (Pacific Islands)

On a few occasions nets were flown within a harbour and emptied before leaving.

USP 31: 19. *USP 32: 42, 43. M 1: 13.*

Collected mid-ocean

Winged specimens, some taken alive, collected 45 n.ml. or more from land.

USP 31: 3, 6. *USP* 39: 15A.

Collected at sea/off shore (Pacific Islands)

Winged specimens taken within 45 n.ml. of the shore.

USP 31: 9, 15. *USP* 32: 40. *M* 4: 3. *M* 6: 1 collection. *M* 15: 1 collection. *M* 17: 1 collection

Collected in harbour (Pacific Islands)

Winged specimens taken aboard ship in harbour.

USP 20: 1 collection. *USP* 31: 15. *USP* 40: 1 collection. *M* 1: 2 collections. *M* 6: 1 collection. *M* 38: 1 collection. *M* 46: 1 collection.

Collected in harbour or after harbour visit (Pacific Islands)

Wingless specimens or others which appeared to be cargo associated.

USP 19: 3, 4, 1 collection. *USP* 28: 7A. *USP* 31: 12, 23. *USP* 32: 29. *USP* 39: 6.

Table 2. *Union South Pacific* Voyage No. 19 (J.A.F. Jenkins, May 1974).

Sample No.	G.M.T Time	G.M.T Date	Wind True Dir.	Wind Vel. (kts)	Starting Lat.	Starting Long.	Ending Lat.	Ending Long.	Vessel Speed (kts)	Vessel Course°	Approx. distance nearest land (n.ml.)†	Arthropods
1	2000	7.V.74	ESE	15	24°42′S	176°58′E	21°20′S	177°34′E	14.5	009	Kadavu, Fiji 135	1 fly
2	2300	8.V.74	SE	09	19°07′S	177°53′E	18°14′S (via Suva)	178°35′E	Var.	Var.	Fiji ◄45	3 beetles 1 wasp
3	2300	8.V.74					18°14′S	178°35′E			Fiji ◄45	1 earwig*
4	0530	10.V.74	NNW	09	16°06′S	177°00′W	15°28′S	174°35′W	14.0	075	Niuafo'ou, Tonga ◄45	1 centipede*
5	1500	11.V.74	Var.	03	Pago Pago		Apia		15.0	Var.	Samoa ◄45	6 wasps 5 flies 1 beetle 1 psocid? 1 insect part
6	1900	12.V.74	SE	13	13°46′S	171°46′W	14°52′S	172°41′W	14.0	Var./205	Samoa ◄45	8 flies 5 moths 1 beetle
7	2220	13.V.74 14.V.74	SE	18/24	17°01′S	173°40′W	20°53′S Nuku'alofa	175°13′W	14.0	205/Var.	Tonga ◄45 Tonga ◄45	10 flies 1 spider*
8	1800	14.V.74	ESE	20	Nuku'alofa		22°16′S	176°16′W	14.5	Var./209	Tonga ◄45	1 weevil

Tables 2-30 † n.ml. – Nautical mile. Note – 1 n.ml. = 1.852km. ◄ Less than * collected by hand

Table 3. *Union South Pacific* Voyage No. 20 (J.A.F. Jenkins, May-June 1974).

Sample No.	G.M.T Time	G.M.T Date	Wind True Dir.	Wind Vel. (kts)	Starting Lat.	Starting Long.	Ending Lat.	Ending Long.	Vessel Speed (kts)	Vessel Course°	Approx. distance nearest land (n.ml.)†	Arthropods
B	2000	22.V.74 30.V.74	E	09	26°07′S Nuku'alofa	176°38′E	22°20′S	177°23′E	14.5	008	Kadavu, Fiji 195 Tonga ◄45	1 wasp 2 moths*
D	2000	31.V.74	ExS	10	27°02′S	178°45′W	30°30′S	178°50′E	15.0	211	Kermadec Is 135	1 wasp 1 fly?

Table 4. *Union South Pacific* Voyage No. 28 (J.A.F. Jenkins, October 1974).

Sample No.	G.M.T		Wind		Starting		Ending		Vessel		Approx. distance nearest land (n.ml.)†	Arthropods
	Time	Date	True Dir.	Vel. (kts)	Lat.	Long.	Lat.	Long.	Speed (kts)	Course°		
2	2100	12.X.74	NW	15	32°19′S	175°44′E	29°06′S	176°24′E	13.5	009	North Cape, NZ 184	1 fly 1 bug?
6	2100	14.X.74	E	13	21°50′S	177°35′E	18°28′S	178°14′E	14.0	028	Fiji ◄45	1 fly
7A		16.X.74					Suva				Fiji ◄45	8 beetles* 6 flies* 5 wasps*
7	0600	16.X.74	ENE	15	17°26′S	179°33′E	16°27′S	178°21′W	12.5	075	Fiji ◄45	1 beetle
10	1830	17.X.74	E	05	15°07′S	173°24′W	14°27′S	170°50′W	13.5	075	Samoa ◄45	2 flies 1 moth
11	0130	19.X.74	Var.	02	13°21′S	170°42′W	13°48′S (via Apia)	171°45′W	Var.	Var.	Samoa ◄45	30 flies 16 wasps 4 aphids 1 psocid
12	0530	19.X.74	ESE	09	13°44′S	171°47′W	14°04′S	172°17′W	13.5	Var./205	Samoa ◄45	1 fly 1 wasp bug parts insect parts
13	2200	19.X.74	SE	20	14°04′S	172°17′W	17°27′S	174°06′W	13.5	205	Samoa ◄45	2 wasps
14	0530	20.X.74	SE	24	17°27′S	174°06′W	19°06′S	174°39′W	14.0	201	Tonga ◄45	1 fly
16	2000	21.X.74	ENE	09	21°00′S	175°23′W	22°56′S	176°40′W	14.0	209	Tonga ◄45	2 beetles
17	0530	22.X.74	E	09	22°56′S	176°40′W	24°30′S	177°36′W	14.0	209	Ata, Tonga 45	1 wasp
20	2100	23.X.74	SxE	05	29°34′S	179°14′E	30°43′S	178°29′E	Var.	Var.	Kermadec Is 129	insect parts
23	0600	25.X.74	NxE	05	33°59′S	176°14′E	35°20′S	175°22′E	10.0	209	New Zealand ◄45	1 fly

Table 5. *Union South Pacific* Voyage No. 31 (J.A.F. Jenkins, December 1974).

Sample No.	G.M.T Time	G.M.T Date	Wind True Dir.	Wind Vel. (kts)	Starting Lat.	Starting Long.	Ending Lat.	Ending Long.	Vessel Speed (kts)	Vessel Course°	Approx. distance nearest land (n.ml.)†	Arthropods
1	0700	3.XII.74	SW	13	34°02′S	175°20′E	31°55′S	175°44′E	13.0	009	Cape Brett, NZ 87	20 flies
2	2000	3.XII.74	SW	15	31°55′S	175°44′E	29°05′S	176°11′E	13.0	009	North Cape, NZ 200	1 fly
3	0400	4.XII.74					27°20′S	176°28′E			Kermadec Is 270	1 fly*
5	2000	4.XII.74	SE	13	26°48′S	176°35′E	23°41′S	177°07′E	13.5	009	Kadavu, Fiji 272	2 flies
6		4.XII.74					22°50′S	177°13′E			Kadavu, Fiji 228	1 butterfly*
7	0700	5.XII.74	S	13	23°41′S	177°07′E	21°17′S	177°30′E	13.5	010	Kadavu, Fiji 128	3 flies
8	2000	5.XII.74	SE	10	21°17′S	177°30′E	18°30′S	178°13′E	14.0	035	Fiji ◀45	2 flies
9	2000	5.XII.74					18°30′S	178°13′E			Fiji ◀45	1 beetle*
10	0600	7.XII.74	E	15	17°25′S	179°56′E	16°25′S	178°10′W	12.0	075	Fiji ◀45	1 bug?
12		7.XII.74			15°29′S	174°39′W					Fiji ◀45	1 spider*
13	0600	8.XII.74	SE	09	15°37′S	175°14′W	15°04′S	173°08′W	13.0	075	Niuafo'ou, Tonga ◀45	2 flies
15		8.XII.74					Pago Pago				Samoa ◀45	1 moth*
16		9.XII.74					13°55′S	172°15′W			Samoa ◀45	1 moth*
17	0600	10.XII.74	Var.	02	14°02′S	172°16′W	15°43′S	173°03′W	14.0	205	Samoa ◀45	2 fly parts
18	1900	10.XII.74	ESE	13	15°43′S	173°03′W	18°20′S	174°22′W	13.0	205	Tonga ◀45	insect parts
19 Nuk		11.XII.74					Nuku'alofa				Tonga ◀45	insect parts
23		14.XII.74					30°37′S	178°45′E			(cargo)	1 earwig*
25	1900	15.XII.74	NE	09	32°56′S	177°12′E	35°13′S	175°33′E	14.0	217	Poor Knights Is, NZ 45	1 lacewing

Table 6. *Union South Pacific* Voyage No. 32 (J.A.F. Jenkins, December 1974-January 1975).

Sample No.	G.M.T Time	G.M.T Date	Wind True Dir.	Wind Vel. (kts)	Starting Lat.	Starting Long.	Ending Lat.	Ending Long.	Vessel Speed (kts)	Vessel Course°	Approx. distance nearest land (n.ml.)†	Arthropods
26	0700	20.XII.74	SSW	13	35°23′S	175°04′E	32°33′S	175°35′E	13.5	009	New Zealand ◄45	2 lacewings
27	0700	20.XII.74					32°33′S	175°35′E			North Cape, NZ 168	1 moth
28	1930	20.XII.74	SSW	13	32°33′S	175°35′E	29°45′S	176°08′E	13.5	009	North Cape, NZ 168	1 lacewing
29		20.XII.74					29°45′S	176°08′E			(cargo)	1 spider*
30	0700	21.XII.74	ESE	18	29°45′S	176°08′E	27°13′S	176°38′E	13.5	008	Kermadec Is 277	1 fly
34	2330	22.XII.74	SSE	09	19°13′S	177°52′E	18°25′S	178°16′E	13.5	028	Fiji ◄45	2 flies 2 wasps 2 aphids
35	1930	24.XII.74	SE	09	17°52′S	179°00′E	16°25′S	178°10′W	13.0	059/075	Fiji ◄45	1 fly 1 ant
36	0600	25.XII.74	Var.	02	16°25′S	178°10′W	15°49′S	175°55′W	13.0	075	Niuafo'ou, Tonga ◄45	1 bug
37	1900	25.XII.74	Var.	05	15°49′S	175°55′W	15°01′S	173°02′W	13.0	074	Niuafo'ou, Tonga ◄45	1 aphid
38	0600	26.XII.74	Var.	05	15°01′S	173°02′W	14°27′S	170°49′W	13.0	075	Samoa ◄45	2 flies 1 aphid
39	0500	28.X11.74	NE	13	15°21′S	172°58′W	17°14′S	173°50′W	14.0	206	Tonga ◄45	1 fly
40		28.XII.74					20°13′S	175°07′W			Tonga ◄45	1 moth*
42		30.XII.74					Nuku'alofa				Tonga ◄45	1 wasp
43		30.XII.74					Nuku'alofa				Tonga ◄45	1 moth
44	0500	31.XII.74	Var.	02	21°10′S	175°30′W	23°33′S	177°03′W	14.0	213/209	Tonga ◄45	1 fly

Table 7. *Union South Pacific* Voyage No. 35 (J.A.F. Jenkins, February-March 1975).

Sample No.	G.M.T		Wind		Starting		Ending		Vessel		Approx. distance nearest land (n.ml.)†	Arthropods
	Time	Date	True Dir.	Vel. (kts)	Lat.	Long.	Lat.	Long.	Speed (kts)	Course°		
5	0615	26.II.75	SE	09	21°14′S	177°41′E	18°52′S	178°02′E	14.0	009/027	Fiji ◄45	2 wasps 1 aphid 1 fly?
6	2000	27.II.75	NW	13	17°36′S	179°14′E	16°14′S	178°06′W	13.5	067	Fiji ◄45	1 fly
7	0600	28.II.75	NNE	09	16°14′S	178°06′W	15°28′S	175°54′W	13.5	067	Niuafo'ou, Tonga ◄45	1 fly part
8	2300	28.II.75	NE	05	15°28′S	175°54′W	13°51′S	172°15′W	13.5	067	Samoa ◄45	1 aphid part
8A	0700	4.III.75	NE	05	15°17′S	171°27′W	17°30′S	173°13′W	14.0	219	Tonga 70	2 bugs 1 fly

Table 8. *Union South Pacific* Voyage No. 36 (J.A.F. Jenkins, March 1975).

Sample No.	G.M.T		Wind		Starting		Ending		Vessel		Approx. distance nearest land (n.ml.)†	Arthropods
	Time	Date	True Dir.	Vel. (kts)	Lat.	Long.	Lat.	Long.	Speed (kts)	Course°		
18	2000	15.III.75	NE	05	23°31′S	177°15′E	20°25′S	177°44′E	14.0	007	Kadavu, Fiji 78	1 aphid
19	0630	16.III.75	NE	09	20°25′S	177°44′E	18°10′S	178°24′E	14.0	Var.	Fiji ◄45	2 flies 1 beetle 2 bugs 1 bug part
20	2000	17.III.75	E	13	18°14′S	178°36′E	16°25′S	178°15′W	13.5	Var./075	Fiji ◄45	1 bug part

Table 9. *Union South Pacific* Voyage No. 39 (J.A.F. Jenkins, May 1975).

Sample No.	G.M.T		Wind		Starting		Ending		Vessel		Approx. distance nearest land (n.ml.)†	Arthropods
	Time	Date	True Dir.	Vel. (kts)	Lat.	Long.	Lat.	Long.	Speed (kts)	Course°		
1	0600	2.V.75	ENE	13	34°47′S	175°14′E	33°40′S	175°30′E	13.5	009	Cape Brett, NZ 53	1 fly 1 fly larva 1 crustacean
5	2130	4.V.75	Var.	02	22°07′S	177°29′E	18°32′S	178°13′E	14.0	006/029	Fiji ◄45	1 wasp
6		6.V.75					Suva				Fiji ◄45	1 cockroach*
9	2300	9.V.75	NNE	09	14°04′S	172°18′W	15°12′S	172°50′W	15.0	205	Samoa ◄45	1 fly 1 bug nymph
10	0500	10.V.75	Var.	05	15°12′S	172°50′W	16°30′S	173°29′W	15.0	205	Tonga ◄45	1 fly 1 spider part
11	1900	10.V.75	Var.	02	16°30′S	173°29′W	19°32′S	174°50′W	15.0	201	Tonga ◄45	1 fly
12	0030	11.V.75	Var.	05	19°32′S	174°50′W	20°50′S	175°12′W	15.0	201/174	Tonga ◄45	1 wasp
13	0400	11.V.75	Var.	05	20°50′S	175°12′W	Nuku'alofa		15/00	174/Var.	Tonga ◄45	4 wasps 1 beetle 1 bug
15A	2100	12.V.75	Var.	02	23°22′S	176°57′W	26°45′S	179°02′W	14.0	209	Ata, Tonga 75	1 ant*
17	2000	13.V.75	SSW	05	28°30′S	179°49′E	31°26′S	178°03′E	14.0	209	Kermadec Is 107	1 aphid

Table 10. *Union South Pacific* Voyage No. 40 (J.A.F. Jenkins, May 1975).

Sample No.	G.M.T		Wind		Starting		Ending		Vessel		Approx. distance nearest land (n.ml.)†	Arthropods
	Time	Date	True Dir.	Vel. (kts)	Lat.	Long.	Lat.	Long.	Speed (kts)	Course°		
19	0000	17.V.75	NW	09	33°55′S	175°20′E	32°28′S	175°36′E	14.00	009	Cape Brett, NZ 94	1 aphid
21	1900	17.V.75	NE	09	31°18′S	175°51′E	28°05′S	176°24′E	14.00	009	North Cape, NZ 233	1 fly
23	2000	18.V.75	E	15/30	25°46′S	176°59′E	22°30′S	177°27′E	13.5	007	Kadavu 202	1 fly
		23.V.75			Apia						Samoa ◄45	1 wasp*
25	0500	24.V.75	ESE	15	14°04′S	172°20′W	15°00′S	172°43′W	14.0	205	Samoa ◄45	2 flies 1 wasp 1 bug 1 insect part
28	2000	25.V.75	ExS	15	20°19′S	175°10′W	Nuku'alofa		14.0/00	Var.	Tonga ◄45	3 flies 2 wasps
29	0500	27.V.75	NW	09	23°36′S	177°08′W	25°20′S	178°10′W	14.0	209	Ata, Tonga 82	2 flies 1 wasp
31	0100	28.V.75	Var.	02	28°17′S	179°58′W	29°15′S	179°25′E	14.0	209	Kermadec Is 78	1 fly 1 moth

Table 11. *Marama* Voyage No. 1 (J.A.F. Jenkins, January 1978).

Sample No.	G.M.T Time	G.M.T Date	Wind True Dir.	Wind Vel. (kts)	Starting Lat.	Starting Long.	Ending Lat.	Ending Long.	Vessel Speed (kts)	Vessel Course°	Approx. distance nearest land (n.ml.)†	Arthropods
1	0500	11.I.78	SW/ Var.	09/02	33°13′S	175°25′E	31°02′S	175°48′E	16.5	008	Cape Brett, NZ 130	5 lacewings 2 flies 1 aphid
2	1930	11.I.78	Var./S	02/05	31°02′S	175°48′E	27°03′S	176°27′E	17.0	008	North Cape, NZ 250	1 weevil
3	0100	12.I.78	S	05	27°03′S	176°27′E	25°20′S	176°47′E	17.0	008	Kermadec Is 330 Hunter I 314	1 fly
4	0700	12.I.78	S	05	25°20′S	176°47′E	23°37′S	177°03′E	17.0	008	Kadavu, Fiji 277 Hunter I 289	1 spider
6	0130	13.I.78	S	05	20°20′S	177°39′E	18°23′S	177°17′E	17.0	346	Fiji ◄45	1 wasp 1 bug
7	1830	15.I.78	ESE	15	17°38′S	178°05′W	17°16′S	177°20′W	16.0	066	Fiji ◄45	1 psocid
8	0100	16.I.78	ESE	15	17°16′S	177°20′W	16°27′S	175°23′W	16.0	066	Niuafo'ou, Tonga 50	1 fly
		17.I.78			Apia						Samoa ◄45	2 bugs*
10	1830	18.I.78	E	09	14°25′S	172°25′W	16°49′S	173°30′W	18.0	205	Samoa ◄45	2 flies
12	0830	19.I.78	E	13	19°12′S	174°36′W	20°49′S	175°14′W	17.5	168	Tonga ◄45	1 aphid
13	0200	20.I.78	SE	18			Nuku'alofa				Tonga ◄45	►25 flies 16 wasps 2 ants 1 bug
		20.I.78					Nuku'alofa				Tonga ◄45	3 wasps*
18	0500	23.I.78	E	13	32°59′S	177°22′E	35°28′S	175°44′E	17.0	208	New Zealand ◄45	1 bug part

► More than.

Table 12. *Marama* Voyage No. 4 (J.A.F. Jenkins, March 1978).

Sample No.	G.M.T		Wind		Starting		Ending		Vessel		Approx. distance nearest land (n.ml.)†	Arthropods
	Time	Date	True Dir.	Vel. (kts)	Lat.	Long.	Lat.	Long.	Speed (kts)	Course°		
1	0300	2.III.78	E'ly	05	16°08'S	174°32'W	15°28'S	173°00'W	15.0	064	Tonga ◄45	fly parts
3	2000	4.III.78	E	05	14°15'S	172°24'W	17°39'S	173°38'W	17.0	219	Samoa ◄45	1 fly 1 ant
3	2000	4.III.78					17°39'S	173°38'W			Tonga ◄45	1 bug*
4	0100	5.III.78	E	02	17°39'S	173°38'W	18°50'S	174°19'W	17.5	207	Tonga ◄45	3 flies

Table 13. *Marama* Voyage No. 5 (J.A.F. Jenkins, March 1978).

Sample No.	G.M.T		Wind		Starting		Ending		Vessel		Approx. distance nearest land (n.ml.)†	Arthropods
	Time	Date	True Dir.	Vel. (kts)	Lat.	Long.	Lat.	Long.	Speed (kts)	Course°		
10	0930	11.III.78	SSE	09	35°28'S	175°03'E	33°53'S	175°17'E	17.5	008	New Zealand ◄45	2 flies 1 moth

Table 14. *Marama* Voyage No. 6 (J.A.F. Jenkins, March-April 1978).

Sample No.	G.M.T		Wind		Starting		Ending		Vessel		Approx. distance nearest land (n.ml.)†	Arthropods
	Time	Date	True Dir.	Vel. (kts)	Lat.	Long.	Lat.	Long.	Speed (kts)	Course°		
15	0400	25.III.78	SW	09	32°41'S	175°26'E	31°36'S	175°36'E	16.0	008	North Cape, NZ 158	1 fly
16	0900	25.III.78	SW	13	31°36'S	175°36'E	30°18'S	175°48'E	16.0	009	North Cape, NZ 215	1 fly
17	2100	25.III.78	ESE	13	30°18'S	175°48'E	27°07'S	176°26'E	15.7	009	North Cape, NZ 286	insect parts
18	0000	26.III.78	ESE	15	27°07'S	176°26'E	26°24'S	176°31'E	15.7	009	Kermadec Is 324	1 insect part
	0400	27.III.78	ESE	18	21°20'S	177°28'E	19°14'S	177°33'E	16.0	008/344	Fiji ◄45	1 beetle*
23	0900	29.III.78	SxE	15	18°12'S	178°26'E	18°12'S	179°49'W	15.5	094/083	Fiji ◄45	1 wasp
24	2100	29.III.78	SxE	15/09	18°12'S	179°49'W	17°14'S	177°10'W	Var.	083/067	Fiji ◄45	2 beetles
25	0230	30.III.78	SxE	05	17°14'S	177°10'W	16°40'S	175°58'W	15.0	068	Niuafo'ou, Tonga 68	1 fly
		30.III.78					Pago Pago				Samoa ◄45	1 beetle* 1 cockroach*
29	0330	2.IV.78	Var.	02	16°58'S	173°28'W	18°05'S	173°57'W	15.0	204	Tonga ◄45	1 fly
31	2200	3.IV.78	S'ly	09	22°22'S	176°20'W	25°10'S	177°57'W	15.0	208	Tonga ◄45	1 beetle

Table 15. *Marama* Voyage No. 10 (J.A.F. Jenkins, June 1978).

Sample No.	G.M.T		Wind		Starting		Ending		Vessel		Approx. distance nearest land (n.ml.)†	Arthropods
	Time	Date	True Dir.	Vel. (kts)	Lat.	Long.	Lat.	Long.	Speed (kts)	Course°		
6	2100	2.VI.78	SE	15	20°58′S	177°23′E	18°14′S	177°12′E	17.0	012/042	Fiji ◄45	insect parts
10	0100	10.VI.78	SE	05	13°53′S	172°12′W	15°05′S	172°54′W	16.0	208	Samoa ◄45	2 flies insect parts
11	1000	10.VI.78	SE	05	15°05′S	172°54′W	17°08′S	173°57′W	15.0	204	Tonga ◄45	6 flies insect parts

Table 16. *Marama* Voyage No. 11 (J.A.F. Jenkins, June 1978).

Sample No.	G.M.T		Wind		Starting		Ending		Vessel		Approx. distance nearest land (n.ml.)†	Arthropods
	Time	Date	True Dir.	Vel. (kts)	Lat.	Long.	Lat.	Long.	Speed (kts)	Course°		
18	0900	19.VI.78	E	15	19°39′S	176°53′E	18°18′S	177°02′E	16.0	013	Fiji ◄45	1 aphid
19	0351	21.VI.78	NE	15	18°13′S	178°29′E	18°13′S	179°52′W	16.5	083	Fiji ◄45	insect parts
21	0300	24.VI.78	NE	09	13°50′S	172°11′W	14°32′S	172°31′W	16.0	205	Samoa ◄45	1 fly 1 ant
22	0830	24.VI.78	ENE	09	14°32′S	172°31′W	15°58′S	173°09′W	16.0	207	Tonga ◄45	5 flies
23	2000	24.VI.78	Var.	02	15°58′S	173°09′W	18°42′S	174°30′W	16.0	201	Tonga ◄45	insect parts
24	2300	24.VI.78	E	05	18°42′S	174°30′W	19°29′S	174°49′W	16.0	201	Tonga ◄45	insect parts
25	0300	25.VI.78	WNW	15	19°29′S	174°49′W	20°32′S	175°15′W	16.0	201	Tonga ◄45	insect parts

Table 17. *Marama* Voyage No. 12 (J.A.F. Jenkins, June-July 1978).

Sample No.	G.M.T		Wind		Starting		Ending		Vessel		Approx. distance nearest land (n.ml.)†	Arthropods
	Time	Date	True Dir.	Vel. (kts)	Lat.	Long.	Lat.	Long.	Speed (kts)	Course°		
38	0515	7.VII.78	SE	05	14°24′S	170°44′W	13°51′S	171°26′W	17.0	311	Samoa ◄45	1 beetle
39	2100	7.VII.78	Var.	05	13°51′S	171°26′W	Apia		17/00	Var.	Samoa ◄45	3 flies
40	0300	8.VII.78	NE	05	13°43′S	171°58′W	14°36′S	172°34′W	16.5	205	Samoa ◄45	1 fly insect parts

Table 18. *Marama* Voyage No. 13 (J.A.F. Jenkins, July 1978).

Sample No.	G.M.T		Wind		Starting		Ending		Vessel		Approx. distance nearest land (n.ml.)†	Arthropods
	Time	Date	True Dir.	Vel. (kts)	Lat.	Long.	Lat.	Long.	Speed (kts)	Course°		
44	0500	15.VII.78	SW	18	33°05′S	175°27′E	32°23′S	175°47′E	17.0	009	Cape Brett, NZ 135	1 psocid
48	2100	19.VII.78	NNE	13	18°17′S	179°42′E	17°55′S	178°56′W	16.0	053	Fiji ◄45	bug parts

Table 19. *Marama* Voyage No. 15 (for J.A.F. Jenkins, August 1978).

Sample No.	G.M.T		Wind		Starting		Ending		Vessel		Approx. distance nearest land (n.ml.)†	Arthropods
	Time	Date	True Dir.	Vel. (kts)	Lat.	Long.	Lat.	Long.	Speed (kts)	Course°		
		22.VIII.78	SE	18	15°50′S	173°40′W			16.5	064	Tonga ◄45	1 wasp*

Table 20. *Marama* Voyage No. 17 (for J.A.F. Jenkins, September 1978).

Sample No.	G.M.T		Wind		Starting		Ending		Vessel		Approx. distance nearest land (n.ml.)†	Arthropods
	Time	Date	True Dir.	Vel. (kts)	Lat.	Long.	Lat.	Long.	Speed (kts)	Course°		
		25.IX.78	SSE	13	18°02′S	174°12′W			17.0	206	Tonga ◄45	1 bug*

Table 21. *Marama* Voyage No. 24 (J.A.F. Jenkins, December 1978-January 1979).

Sample No.	G.M.T		Wind		Starting		Ending		Vessel		Approx. distance nearest land (n.ml.)†	Arthropods
	Time	Date	True Dir.	Vel. (kts)	Lat.	Long.	Lat.	Long.	Speed (kts)	Course°		
1	0300	30.XII.78	SSE	18	33°04′S	175°29′E	30°59′S	175°47′E	17.0	008	Cape Brett, NZ 138	1 insect part
3	2100	30.XII.78	S	30	29°15′S	176°00′E	25°56′S	176°23′E	17.0	008	Kermadec Is 295 Hunter I 319	insect parts
5	0900	31.XII.78	SSW	15	24°48′S	176°50′E	22°27′S	177°09′E	17.0	009	Kadavu, Fiji 202	insect parts
6	2100	31.XII.78	WSW	05	22°27′S	177°09′E	19°06′S	177°10′E	17.0	000	Fiji ◄45	1 bug part
8	0300	4.I.79	Var.	05	15°50′S	176°53′W	15°01′S	175°02′W	17.0	067	Niuafo'ou, Tonga ◄45	1 fly 1 psocid
10	0300	6.I.79	Var.	05	14°30′S	170°50′W	15°55′S	171°45′W	17.0	218	Samoa ◄45	1 wasp 1 fly
12	2100	6.I.79	Var.SW	05/ 13-24	17°13′S	172°58′W	19°44′S	174°49′W	17.0	214/207	Tonga ◄45	1 psocid
15	0000	10.I.79	NE	02	32°22′S	177°31′E	33°48′S	176°37′E	17.0	208	Cape Brett, NZ 142	1 wasp
17	0800	10.I.79	NW	05	34°43′S	176°00′E	35°40′S	175°10′E	17.0	208	New Zealand ◄45	2 wasps

Table 22. *Marama* Voyage No. 25 (J.A.F. Jenkins, January 1979).

Sample No.	G.M.T		Wind		Starting		Ending		Vessel		Approx. distance nearest land (n.ml.)†	Arthropods
	Time	Date	True Dir.	Vel. (kts)	Lat.	Long.	Lat.	Long.	Speed (kts)	Course°		
18	1930	12.I.79	Var	02	35°05′S	175°07′E	31°40′S	175°42′E	17.0	008	New Zealand ◄45	1 psocid
19	0000	13.I.79	E′ly	05	31°40′S	175°42′E	30°21′S	175°54′E	17.0	008	North Cape, NZ 208	1 wasp
24	0100	17.I.79	NW	09	18°13′S	178°28′E	17°18′S	179°46′E	17.0	060	Fiji ◄45	3 wasps 1 ant 1 aphid 1 bug part 1 spider fly parts insect parts
25	0900	17.I.79	N	24/09	17°18′S	179°46′E	16°17′S	178°06′W	17.0	060/067	Fiji ◄45	1 insect part
26	2000	17.I.79	Var.	09	16°17′S	178°06′W	15°09′S	175°05′W	17.0	067	Niuafo'ou, Tonga ◄45	1 fly
27	0230	18.I.79	Var.	05	15°09′S	175°05′W	14°12′S	173°11′W	17.0	065	Niuafo'ou, Tonga ◄45	beetle parts ant parts 1 insect part
28	0530	18.I.79	Var.	05	14°12′S	173°11′W	13°59′S	172°32′W	17.0	065	Samoa ◄45	1 beetle 1 beetle part weevil parts 1 aphid 1 wasp part
29	0930	18.I.79	Var.	05	13°59′S	172°32′W	Apia		17/00	Var.	Samoa ◄45	6 flies 2 beetles? 1 moth 1 moth part? insect parts
30	0300	20.I.79	S	13	14°33′S	170°52′W	15°49′S	171°52′W	17.0	218	Samoa ◄45	1 fly
31	0800	20.I.79	SE	13	15°49′S	171°52′W	16°58′S	172°39′W	17.0	218	Tafahi, Tonga 88	1 fly?
34	1900	23.I.79	Var.	05	28°45′S	179°49′E	32°20′S	177°36′E	17.0	208	Kermadec Is 124	1 fly
35	0200	24.I.79	Var.	05	32°20′S	177°36′E	34°05′S	176°33′E	17.0	209	Cape Brett, NZ 131	5 wasps 2 aphids 1 butterfly
36	0730	24.I.79	SE	09	34°05′S	176°33′E	35°30′S	175°40′E	17.0	209	New Zealand ◄45	2 wasps

Table 23. *Marama* Voyage No. 30 (J.A.F. Jenkins, April 1979).

Sample No.	G.M.T		Wind		Starting		Ending		Vessel		Approx. distance nearest land (n.ml.)†	Arthropods
	Time	Date	True Dir.	Vel. (kts)	Lat.	Long.	Lat.	Long.	Speed (kts)	Course°		
1	0345	7.IV.79	ENE	13	33°04′S	175°19′E	31°24′S	175°27′E	17.0	006	North Cape, NZ 140	1 fly
2	0930	7.IV.79	ExS	13	31°24′S	175°27′E	29°46′S	175°38′E	17.0	006	North Cape, NZ 223	3 flies 1 wasp
3	1945	7.IV.79	E	09	29°46′S	175°38′E	26°49′S	175°59′E	17.0	007	Kermadec Is 305	1 fly
4	0310	8.IV.79	SE	15	26°49′S	175°59′E	24°45′S	176°15′E	17.0	007	Hunter I 275	1 fly
5	1010	8.IV.79	SE	15	24°45′S	176°15′E	22°50′S	176°35′E	17.0	007	Kadavu, Fiji 236 Hunter I 255	1 fly part
6	2100	8.IV.79	SSE	15	22°50′S	176°35′E	19°51′S	176°55′E	17.0	006	Kadavu, Fiji 77	1 fly
7	0350	9.IV.79	SSE	18	19°51′S	176°55′E	18°02′S	177°08′E	17.0	010	Fiji ◄45	fly parts
8	0500	14.IV.79	SExE	09	14°27′S	170°47′W	15°34′S	171°42′W	17.0	218	Samoa ◄45	1 fly
9	0900	14.IV.79	SSE	13	15°34′S	171°42′W	16°27′S	172°24′W	17.0	218	Niuatoputapu, Tonga 85	insect parts
10	2000	14.IV.79	ESE	05	16°27′S	172°24′W	18°55′S	174°20′W	17.0	218/209	Tonga ◄45	1 wasp

Table 24. *Marama* Voyage No. 31 (J.A.F. Jenkins, April-May 1979).

Sample No.	G.M.T		Wind		Starting		Ending		Vessel		Approx. distance nearest land (n.ml.)†	Arthropods
	Time	Date	True Dir.	Vel. (kts)	Lat.	Long.	Lat.	Long.	Speed (kts)	Course°		
13	0900	21.IV.79	ESE	09	32°18′S	175°22′E	30°49′S	175°32′E	16.5	006	North Cape, NZ 170	insect parts
14	2100	21.IV.79	ESE	09	30°49′S	175°32′E	27°28′S	175°59′E	16.5	006	North Cape, NZ 258	1 wasp part
15	0100	22.IV.79	SE	09	27°28′S	175°59′E	26°24′S	176°05′E	16.5	006	Kermadec Is 337	1 wasp part
20	0945	25.IV.79	SE	15/24	17°43′S	179°06′E	16°54′S	179°30′W	16.5	046/062	Fiji ◄45	1 aphid
23	1530	26.IV.79	Var.	05	14°27′S	173°53′W	13°46′S	171°45′W	16.5	067/Var.	Samoa ◄45	1 moth
24	0200	1.V.79	S	24/18	26°20′S	178°45′W	27°45′S	179°31′W	16.5	208	Kermadec Is 120	1 fly

Table 25. *Marama* Voyage No. 32 (J.A.F. Jenkins, May 1979).

Sample No.	G.M.T		Wind		Starting		Ending		Vessel		Approx. distance nearest land (n.ml.)†	Arthropods
	Time	Date	True Dir.	Vel. (kts)	Lat.	Long.	Lat.	Long.	Speed (kts)	Course°		
26	0400	10.V.79	SSE	05	18°06′S	178°48′E	17°04′S	179°49′W	17.0	040/060	Fiji ◄45	1 fly 1 beetle 1 aphid
27	0900	10.V.79	SSE	09	17°04′S	179°49′W	16°27′S	178°33′W	16.5	060/067	Fiji ◄45	2 flies

Table 26. *Marama* Voyage No. 37 (J.A.F. Jenkins, July-August 1979).

Sample No.	G.M.T		Wind		Starting		Ending		Vessel		Approx. distance nearest land (n.ml.)†	Arthropods
	Time	Date	True Dir.	Vel. (kts)	Lat.	Long.	Lat.	Long.	Speed (kts)	Course°		
1	0020	21.VII.79	SE	05	32°05′S	175°25′E	31°13′S	175°29′E	17.5	006	North Cape, NZ 178	1 thrips
3	0945	21.VII.79	ExS	09	29°25′S	175°44′E	28°32′S	175°48′E	17.0	007	Kermadec Is 312	1 psocid nymph
5	0500	30.VII.79	ENE	09	21°28′S	175°43′W	22°43′S	176°30′W	17.0	210	Tonga ◄45	1 insect part
8	0100	31.VII.79	NExN	13	26°28′S	178°46′W	27°45′S	179°30′W	17.0	208	Kermadec Is 121	insect parts

Table 27. *Marama* Voyage No. 38 (J.A.F. Jenkins, August 1979).

Sample No.	G.M.T		Wind		Starting		Ending		Vessel		Approx. distance nearest land (n.ml.)†	Arthropods
	Time	Date	True Dir.	Vel. (kts)	Lat.	Long.	Lat.	Long.	Speed (kts)	Course°		
12	0030	4.VIII.79	SW	09	33°17′S	175°18′E	32°17′S	175°25′E	17.0	006	Cape Brett, NZ 123	1 fly
13	0430	4.VIII.79	SSW	13	32°17′S	175°25′E	31°10′S	175°32′E	17.0	006	North Cape, NZ 174	2 flies
14	0900	4.VIII.79	SW	09	31°10′S	175°32′E	29°55′S	175°42′E	17.0	006	North Cape, NZ 235	1 fly 2 psocid nymphs
16	0015	12.VIII.79	SxE	05	26°56′S	176°03′E	25°46′S	176°10′E	17.0	006	Kermadec Is 352 Hunter I 307	1 fly 1 psocid nymph
		12.VIII.79					Nuku'alofa				Tonga ◄45	1 fly*
25	2000	13.VIII.79	NW	13	23°42′S	177°06′W	26°17′S	178°39′W	17.0	208	Ata, Tonga 95	1 fly
26	0100	14.VIII.79	NW	18	26°17′S	178°39′W	27°36′S	179°24′W	17.0	208	Kermadec Is 122	1 psocid nymph

Table 28. *Marama* Voyage No. 42 (J.A.F. Jenkins, September-October 1979).

Sample No.	G.M.T Time	G.M.T Date	Wind True Dir.	Wind Vel. (kts)	Starting Lat.	Starting Long.	Ending Lat.	Ending Long.	Vessel Speed (kts)	Vessel Course°	Approx. distance nearest land (n.ml.)†	Arthropods
1	0100	29.IX.79	SE	09	33°05′S	175°19′E	31°56′S	175°25′E	16.8	006	North Cape, NZ 142	3 flies 1 psocid
4	2100	29.IX.79	SxE	18	29°10′S	175°46′E	26°25′S	176°05′E	16.5	006	Kermadec Is 300	1 fly
5	0100	30.IX.79	SExE	20	26°25′S	176°05′E	25°10′S	176°13′E	16.5	006	Hunter I 273	1 fly
7	1945	30.IX.79	ESE	05	24°23′S	176°17′E	20°18′S	176°41′E	17.0	007	Kadavu, Fiji 105	2 flies 1 fly part 1 insect part
10	0430	3.X.79	ExN	09	18°12′S	178°24′E	17°15′S	179°50′E	16.0	040/060	Fiji ◀45	1 wasp 1 aphid 1 fly?
12	1900	3.X.79	E	05	16°34′S	178°49′W	15°35′S	176°31′W	16.5	067	Fiji ◀45	1 wasp
18	1900	6.X.79	ExN	05	16°31′S	172°27′W	18°37′S	174°12′W	16.5	218	Tonga ◀45	1 wasp
19	2330	6.X.79	ExN	09	18°37′S	174°12′W	19°43′S	174°36′W	16.5	207	Tonga ◀45	insect parts
20	0400	7.X.79	ExN	09	19°43′S	174°36′W	20°50′S	175°12′W	16.5	207/180	Tonga ◀45	1 wasp insect parts
21	2000	8.X.79	NE	05	23°20′S	176°56′W	25°57′S	178°26′W	16.5	208	Ata, Tonga 65	1 fly
22	0100	9.X.79	NNE	09	25°57′S	178°26′W	27°16′S	179°12′W	16.5	208	Kermadec Is 135	1 fly

Table 29. *Marama* Voyage No. 43 (J.A.F. Jenkins, October 1979).

Sample No.	G.M.T Time	G.M.T Date	Wind True Dir.	Wind Vel. (kts)	Starting Lat.	Starting Long.	Ending Lat.	Ending Long.	Vessel Speed (kts)	Vessel Course°	Approx. distance nearest land (n.ml.)†	Arthropods
25	1000	21.X.79	SW	09	24°25′S	176°25′E	23°21′S	176°30′E	16.0	007	Hunter I 255 Kadavu, Fiji 260	1 fly insect parts

Table 30. *Marama* Voyage No. 46 (J.A.F. Jenkins, December 1979).

Sample	G.M.T		Wind		Starting		Ending		Vessel		Approx. distance	Arthropods
No.	Time	Date	True Dir.	Vel. (kts)	Lat.	Long.	Lat.	Long.	Speed (kts)	Course°	nearest land (n.ml.)†	
9	0330	19.XII.79	ESE	18	16°09′S	177°49′W	15°34′S	176°26′W	16.0	067	Niuafo'ou, Tonga ◄45	1 beetle larva?
		21.XII.79			Apia						Samoa ◄45	1 bee*
14	0500	24.XII.79	SExE	18	21°08′S	175°28′W	22°36′S	176°27′W	17.0	208	Tonga ◄45	1 wasp 1 bug part 1 insect part
16	0000	25.XII.79	ESE	18	26°10′S	178°34′W	27°15′S	179°13′W	16.5	208	Kermadec Is 135	1 wasp 1 wasp part 1 insect part

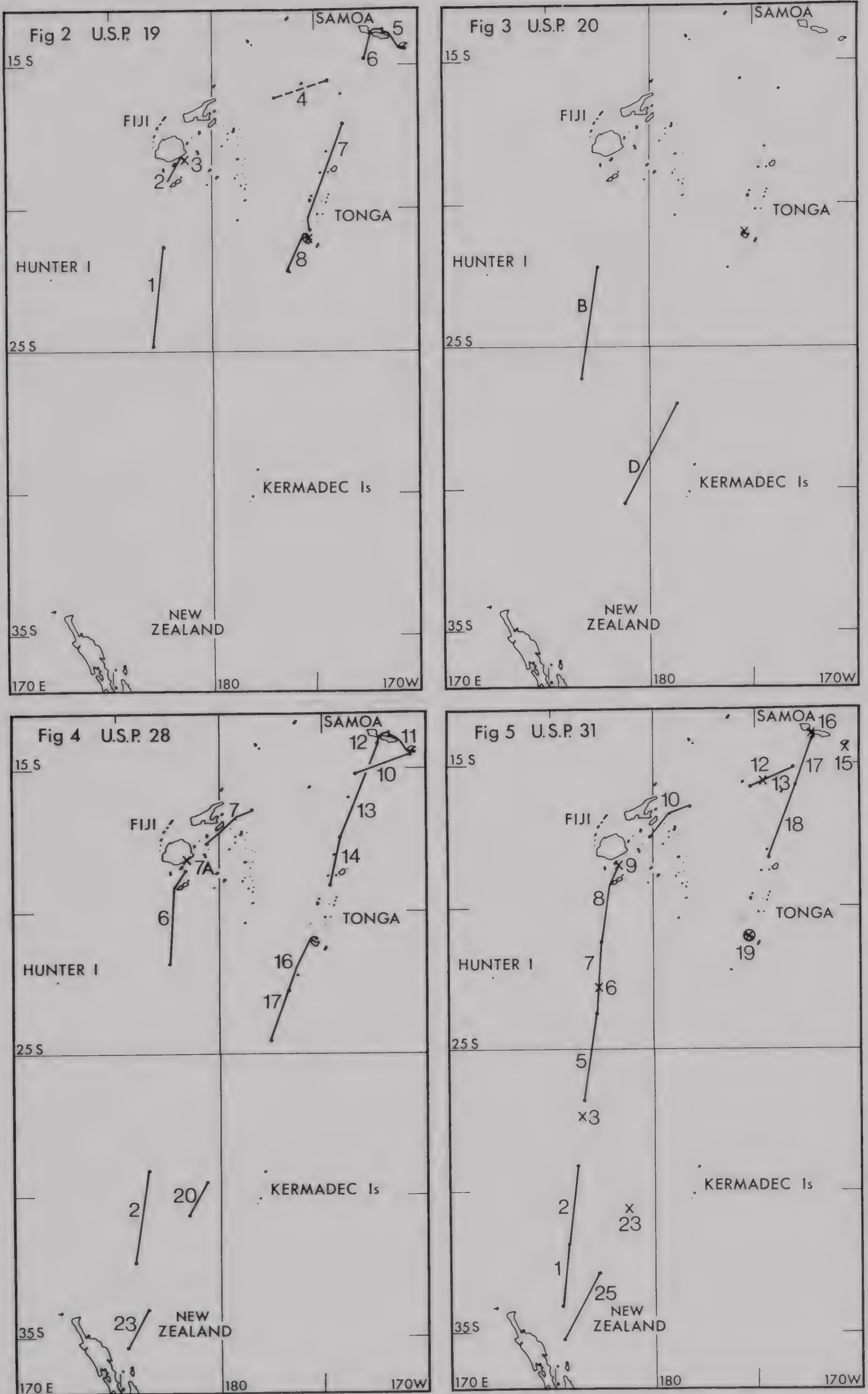
Key to Figures 2-25

—— Solid line indicates successful net run — specimen(s) trapped.

---- Dashed line indicates specimen(s) hand collected during run.

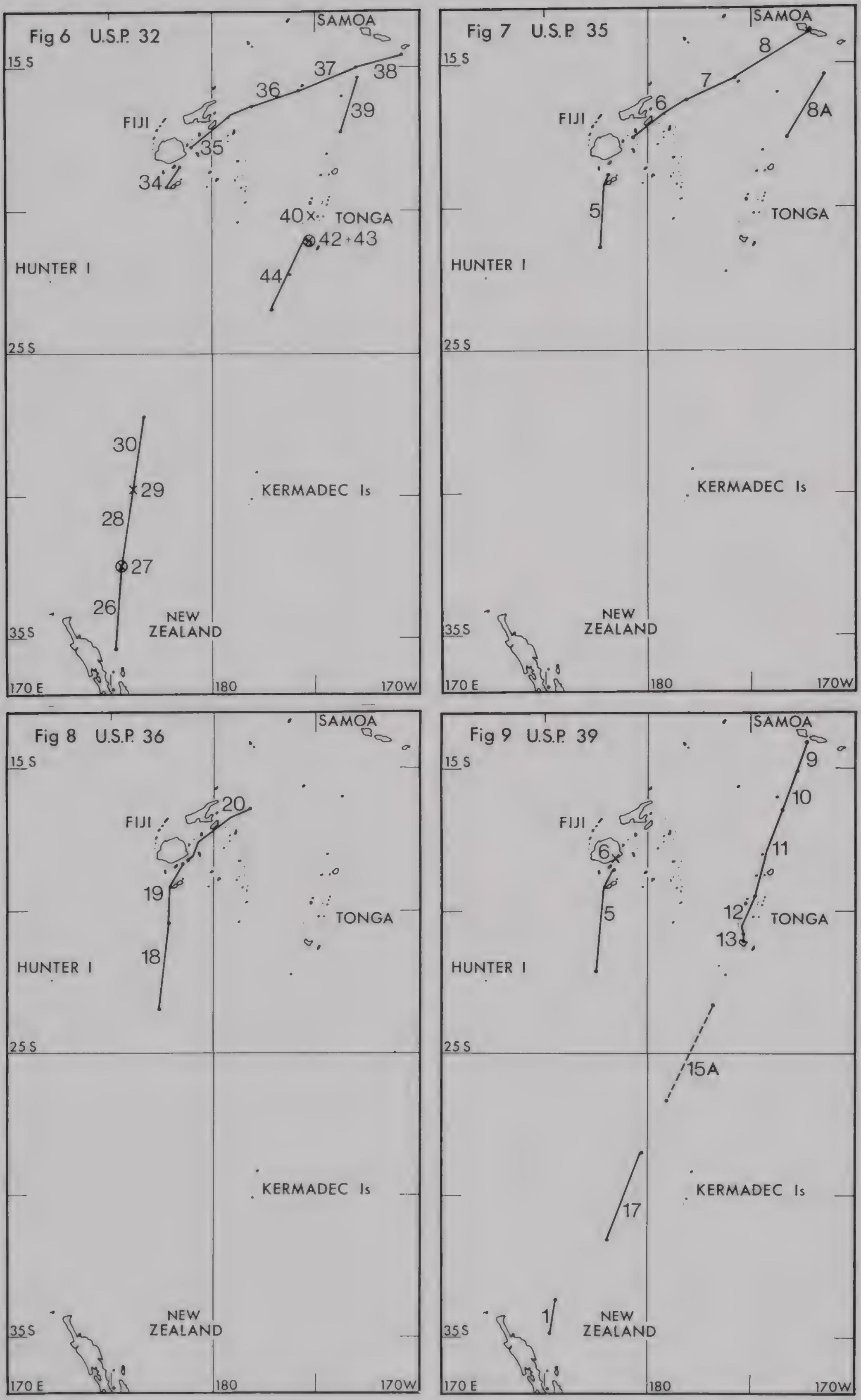
× Cross indicates a position for hand collected specimen(s).

⊗ Cross in circle indicates a position for trapped specimen(s).

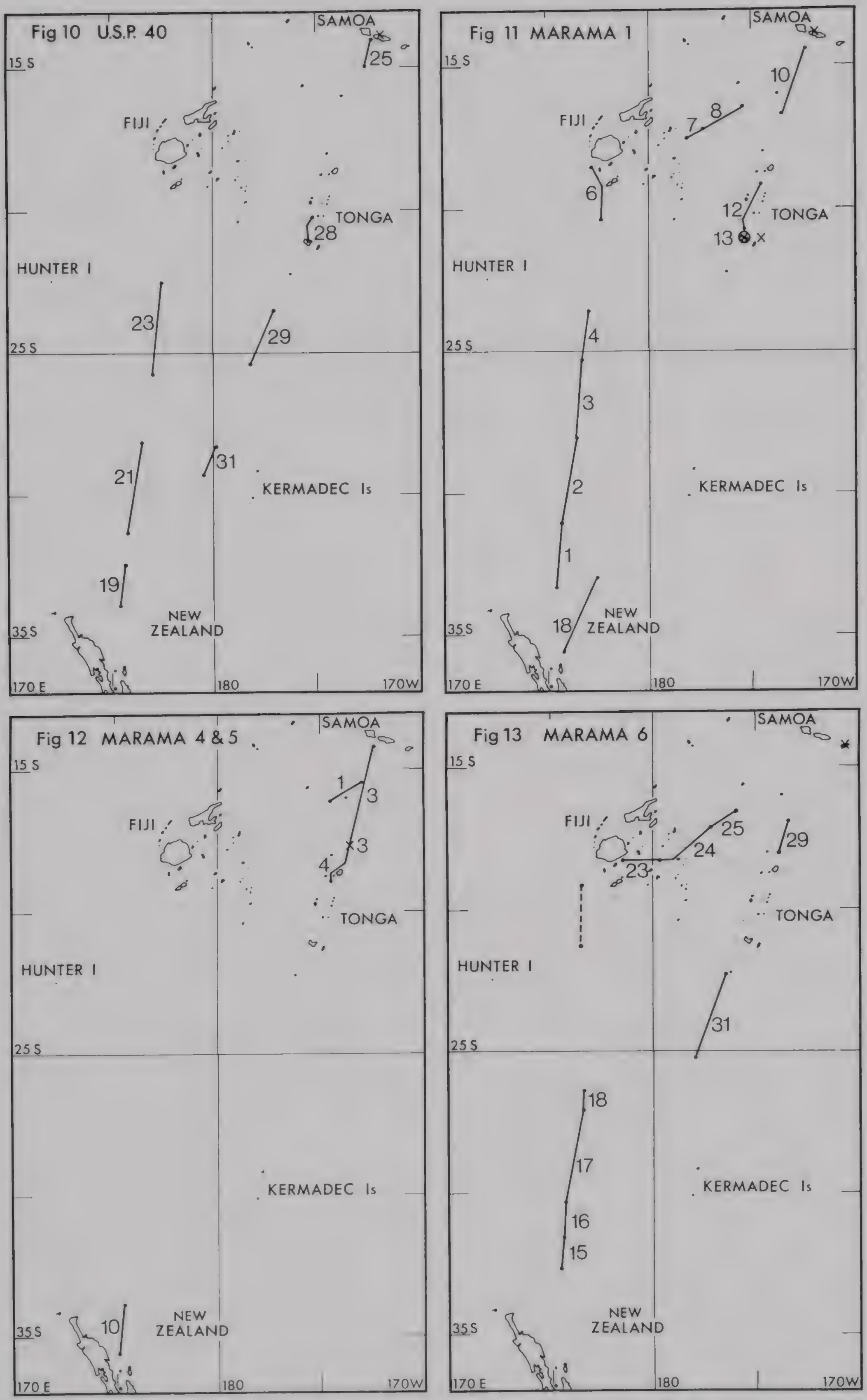


Figs. 2-5. Successful net runs and collections on *Union South Pacific* voyages. 2. Voyage No. 19 (May 1974). 3. Voyage No. 20 (May-June 1974). 4. Voyage No. 28 (Oct. 1974). 5. Voyage No. 31 (Dec. 1974).

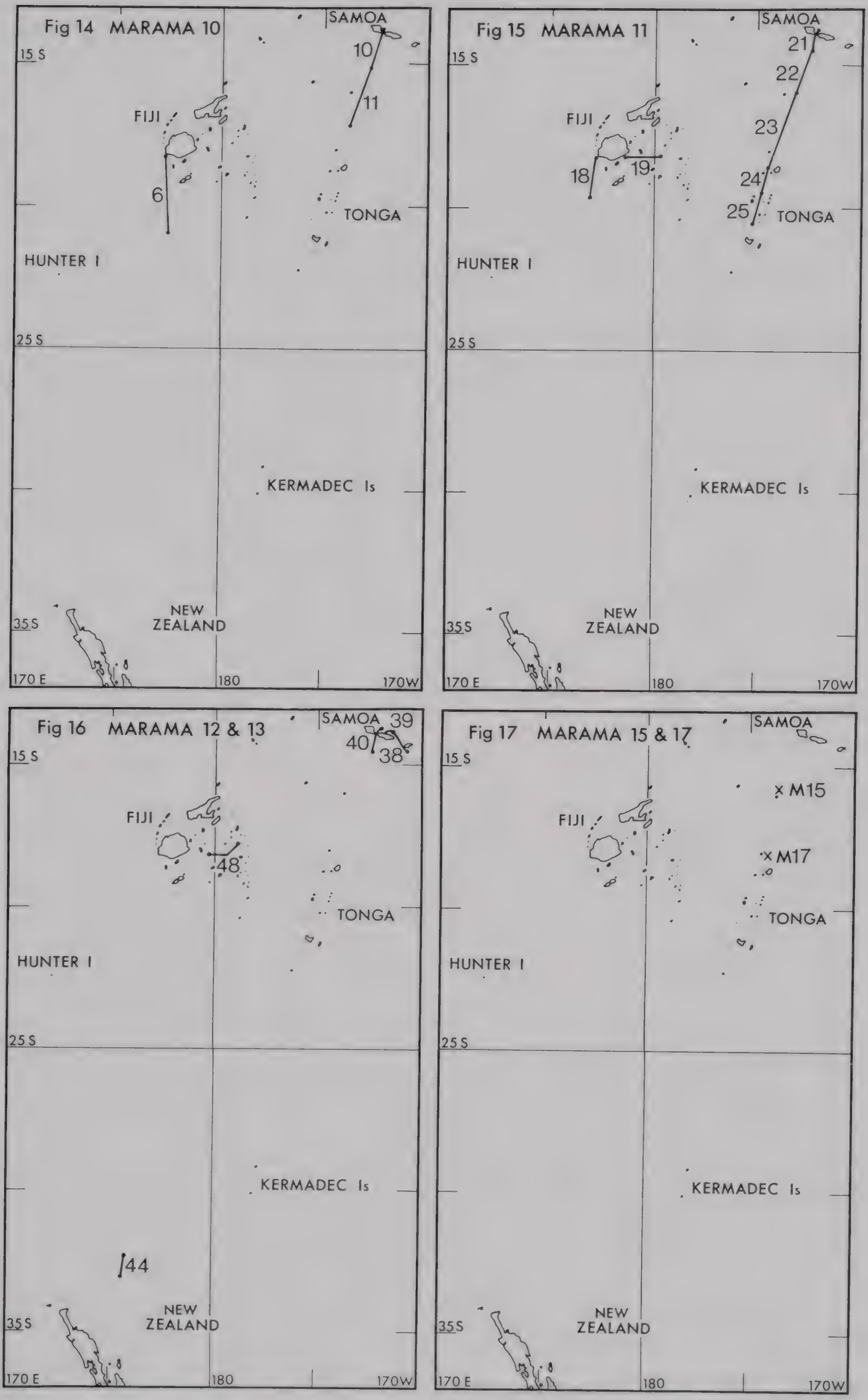
[For Key to Figures 2-25 see page 245]



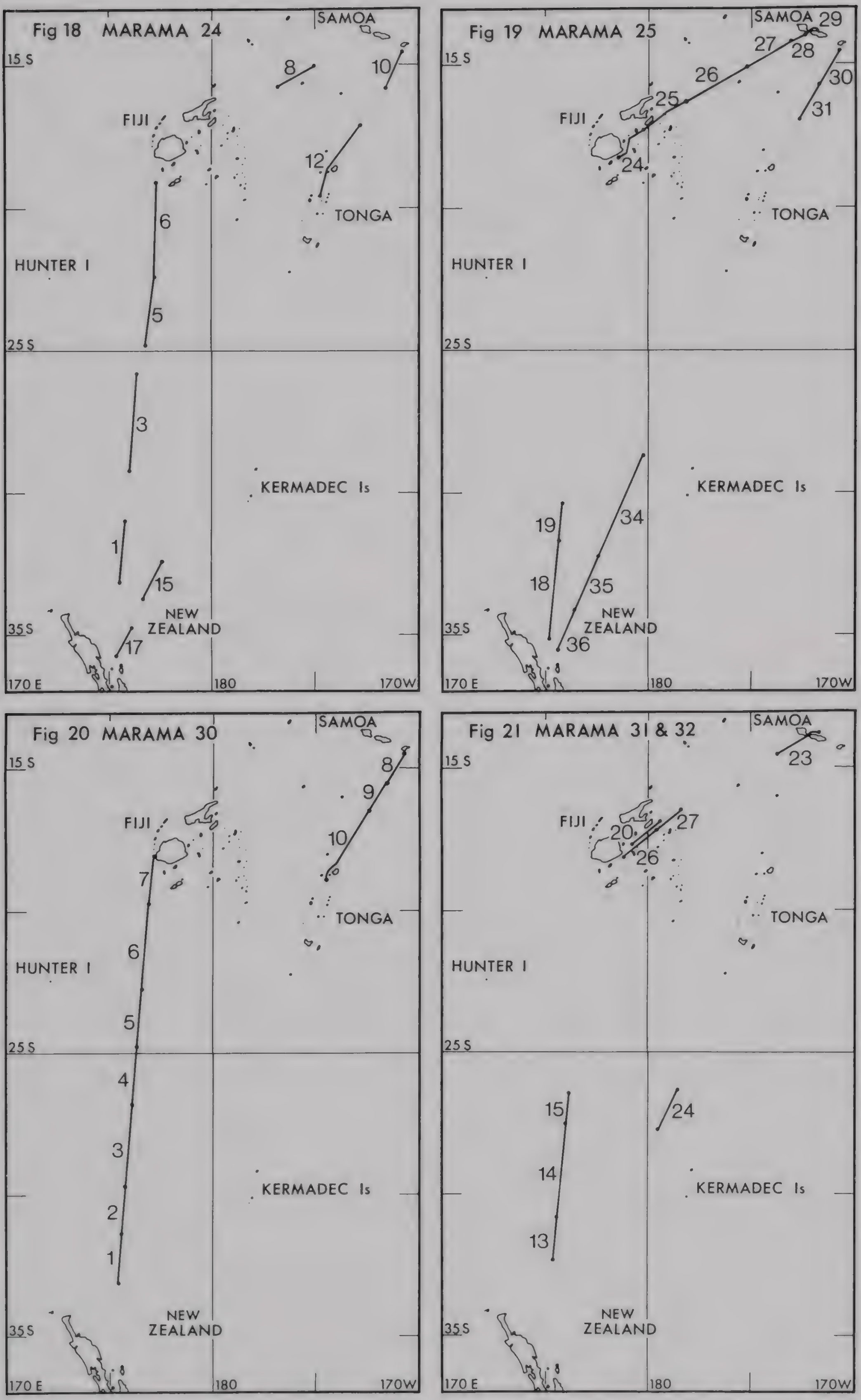
Figs. 6-9. Successful net runs and collections on *Union South Pacific* voyages. 6. Voyage No. 32 (Dec. 1974-Jan. 1975). 7. Voyage No. 35 (Feb.-March 1975). 8. Voyage No. 36 (March 1975). 9. Voyage No. 39 (May 1975).



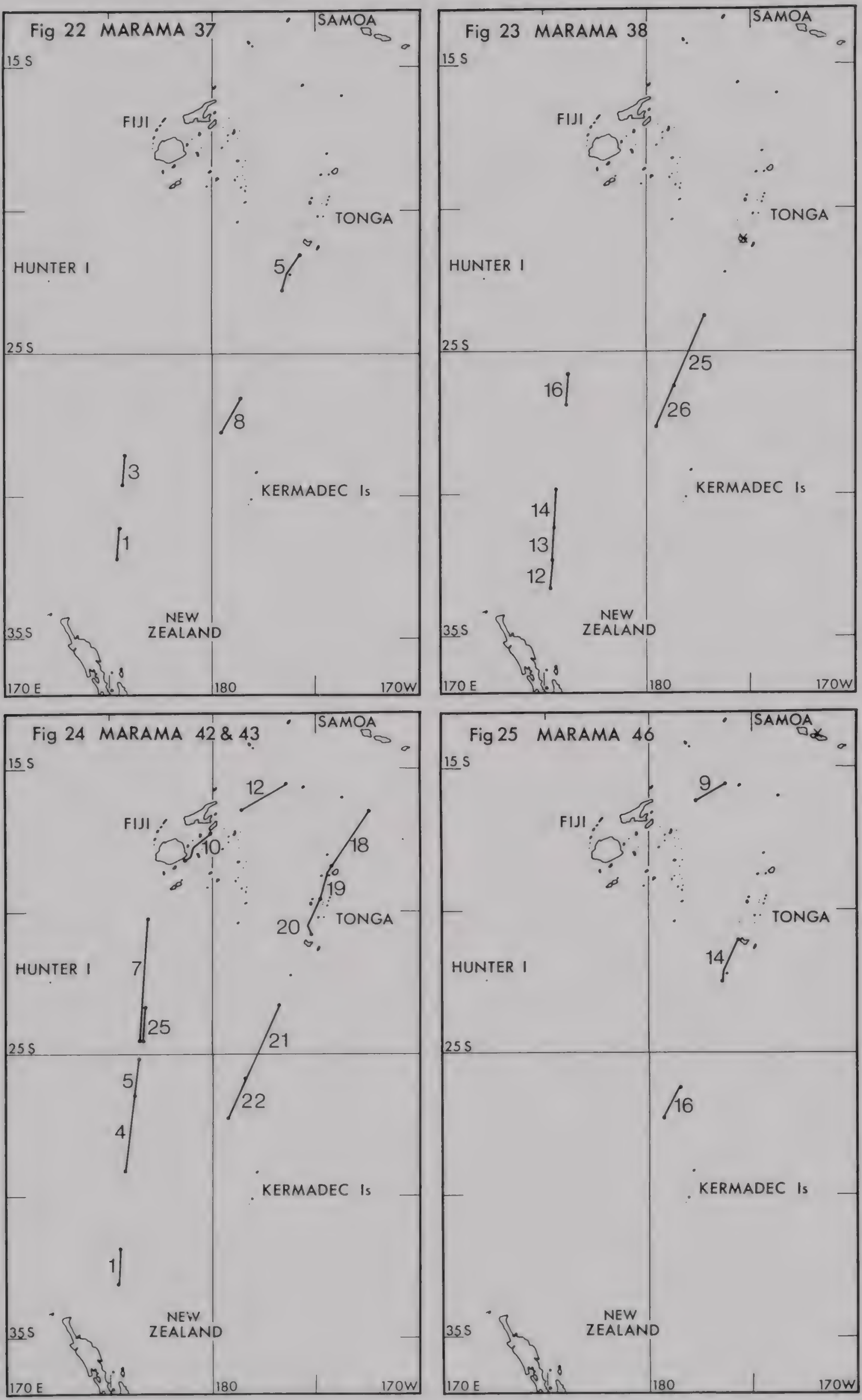
Figs. 10-13. 10. Successful net runs and collections on *Union South Pacific* Voyage No. 40 (May 1975). 11-13. Successful net runs and collections on *Marama* voyages. 11. Voyage No. 1 (Jan. 1978). 12. Voyages No's. 4, 5 (March 1978). 13. Voyage No. 6 (March-April 1978).



Figs. 14-17. Successful net runs and collections on *Marama* voyages. 14. Voyage No. 10 (June 1978). 15. Voyage No. 11 (June 1978). 16. Voyages No. 12 (June-July 1978), No. 13 (July 1978). 17. Voyages No. 15 (Aug. 1978), No. 17 (Sept. 1978).



Figs. 18-21. Successful net runs and collections on *Marama* voyages. 18. Voyage No. 24 (Dec. 1978-Jan. 1979). 19. Voyage No. 25 (Jan. 1979). 20. Voyage No. 30 (April 1979). 21. Voyages No. 31 (April-May 1979), No. 32 (May 1979).



Figs. 22-25. Successful net runs and collections on *Marama* voyages. 22. Voyage No. 37 (July-Aug. 1979). 23. Voyage No. 38 (Aug. 1979). 24. Voyages No. 42 (Sept-Oct. 1979), No. 43 (Oct. 1979). 25. Voyage No. 46 (Dec. 1979).

ARTHROPOD FAUNA

Many bugs including aphids (Hemiptera), beetles (Coleoptera), moths (Lepidoptera), flies (Diptera), parasitic and social wasps and winged ants (Hymenoptera), and insect parts were taken in the nets. Also in the nets were psocids (Psocoptera), lacewings (Neuroptera), thrips (Thysanoptera), one small butterfly (Lepidoptera) and insect exuviae. A few wingless specimens, an ant (Hymenoptera), spiders (Araneae) and an amphipod (Crustacea), may have crawled into nets before they were set.

Many other specimens were hand collected on the ships, particularly after leaving New Zealand and after visiting ports in the Pacific Islands: earwigs (Dermaptera) a cockroach (Blattodea), bugs (Hemiptera), beetles (Coleoptera), moths and butterflies (Lepidoptera), flies (Diptera), parasitic and social wasps, a winged ant and a bee (Hymenoptera), spiders (Araneae) and a centipede (Chilopoda).

Acknowledgements. The late Dr J. Linsley Gressitt, Chairman, Entomology Department, Bernice P. Bishop Museum, Honolulu, Hawaii, initiated the insect dispersal projects which have supplied so much biogeographical information. The opportunity to work with him is still much appreciated and the current studies are seen as a continuation of his work.

The Auckland Museum Entomology Department project would not have been possible without the impetus and action of Captain J.A.F. Jenkins, who has continued the trapping of insects at sea over many years. John Jenkins has personally attended to the taking and care of samples and concurrent recording of data, and also to maintenance of nets and net rings. He has kindly checked data, re-drawn maps and answered innumerable questions, all of which assisted greatly in the production of this paper.

The use of Union Steamship Company ships for this project is also acknowledged. Mr N.G. Cheshire, Deck Officer, assisted by drafting original maps. Many crew members on the ships have assisted with the handling of nets and the collection of specimens.

Ms Caroline Phillips, Auckland, has prepared the figures for publication.

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LACEWINGS AND AQUATIC INSECTS OF NEW ZEALAND

1. Three new northern distribution records

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Abstract. Two lacewings and an aquatic beetle are recorded further north in the North I. than previously known: *Micromus bifasciatus* Tillyard, 1923 (Neuroptera: Hemerobiidae) near Auckland (Waitemata Co.), *Cryptoscenea australiensis* (Enderlein, 1906) (Neuroptera: Coniopterygidae) and *Gyrinus convexiusculus* Macleay, 1873 (Coleoptera: Gyrinidae), both in the far north (Mangonui Co.).

This new series of papers is intended to provide further records of lacewings (Order Neuroptera) and aquatic insects (several Orders) in order to make them more quickly and readily available.

Unless otherwise stated specimens are in the collections of the Auckland Museum.

Micromus bifasciatus Tillyard, 1923 (Neuroptera: Hemerobiidae)

This endemic species was earlier recorded (Wise 1963) in the South I. and as far north as Gisborne in the North I.

Following an observation by Mrs B.M. May of Huia, west of Auckland (Waitemata Co.), a search was made in 1982 on trees she had indicated in that district and an adult and larvae were collected. This is an active colony known for several years.

Cryptoscenea australiensis (Enderlein, 1906) (Neuroptera: Coniopterygidae)

After many years searching, Coniopterygid lacewings were re-discovered in New Zealand in 1959 and recognised as this Australian species (Kimmins & Wise 1962). An active population was found at Mangere, Auckland, feeding on mealybugs (*Trionymus wisei* Williams & de Boer, 1973) on rushes. Since then other records of the species have been made (Kimmins & Wise 1962, Wise 1963) and individuals have been recorded feeding on mites on fruit trees (Collyer 1964). There are also previously unrecorded specimens from North Auckland, one taken in the Bay of Islands Co. (National Museum collection) and two in the Hokianga Co. (Entomology Division collection).

Recently, in 1983, a female was collected at Motutangi swamp in the far north (Mangonui Co.) in a ground crevice where rushes were growing.

Rec. Auckland Inst. Mus. 20: 255-257 23 December 1983

Gyrinus convexiusculus Macleay, 1873 (Coleoptera: Gyrinidae)

A species of whirligig beetle was apparently first recorded for New Zealand by Hutton (1873:246) who mentioned *Gyrinus natator* as being one of four aquatic beetles present in this country and also noted this species as being in Britain. It would appear he used the name of the European species for the species present in New Zealand. In a list of New Zealand species published a year later Hutton (1874) listed only "*Gyrinus striolatus* Guerin, Voy. Coquille, 62.". This is a large Australian species now known as *Macrogyrus striolatus* (Guerin, 1838) and there is no suspicion that it occurs in this country. Later in the 1870s, Pascoe (1877) described a new species from New Zealand as *Gyrinus huttoni*. He gave the locality as Waikato and mentioned a specimen received from Captain Hutton. This then was the gyrinid species recorded from New Zealand and based on at least one specimen.

Subsequently, Broun (1880) recorded the species *Gyrinus huttoni* and quoted Pascoe's description and comments in their entirety, the personal pronouns used being Pascoe's not Broun's. This species was also listed by Hutton (1904), mentioned by Tillyard (1926:194) and recorded by Hudson (1934:43,179).

Later, in a revision of the Australian Gyrinidae, Ochs (1949) synonymised *G. huttoni* Pascoe, 1877 with the widespread species *Gyrinus convexiusculus* Macleay, 1873, which was also recorded from India to Australia and New Caledonia.

However, the species seemed to have disappeared from New Zealand as no new records based on specimens had been made since the early records in the 1870s and no specimens were present in current collections in New Zealand. Wise (1973:145) and McLellan (1975:557) noted this lack of confirmation that the Family Gyrinidae occurred here.

More recently, since 1977, whirligig beetles have been re-discovered in the Waikato Valley (Waipa Co.), and recorded as *Gyrinus convexiusculus* by Chapman (1982). This is undoubtedly the same area as the original locality record of "Waikato" and lies in the South Auckland section of the Auckland Province. Subsequent to that collection, the species has also been recorded and figured by Winterbourn & Gregson (1981:39,43) and Helmore (1982).

The discovery of another population of the same species, in the far north of the North Auckland section of the province, is now reported. Whirligig beetles were seen by the author on the surface of a man-made pond within the northern Mangonui Co. in early 1983. Specimens taken then and since are determined as *Gyrinus convexiusculus* Macleay, 1873. This isolated occurrence is so far unexplained but the colony is being monitored and searches for other occurrences in the area are being made. It is intended to publish full details and lodge specimens in other institutions when this study is completed.

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Curators of National Museum, Wellington, and Entomology Division, D.S.I.R., Auckland, have kindly given access to their Neuroptera collections.

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LACEWINGS AND AQUATIC INSECTS OF NEW ZEALAND

2. Fauna of the northern offshore islands

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Abstract. Records of aquatic insects and lacewings are given in a table for each Order. Sources of records include references to previous publications and to known specimens.

Represented in the offshore islands fauna are the Neuroptera and the aquatic Ephemeroptera, Odonata, Plecoptera, Megaloptera, Trichoptera and some families of Hemiptera, Coleoptera and Diptera.

In an area of prevailing westerly winds the offshore islands are mostly east of the North I mainland and the fauna comprises North I species.

This paper, which is mainly a faunal list in tabular form, was presented in part to the Offshore Islands Research Group Symposium on "The offshore islands of northern New Zealand", at Auckland in May 1983. The islands included extend from the Three Kings Islands, *ca.* 60 km north-west of the North Island, along the east coast southwards as far as the Bay of Plenty.

Lacewings and aquatic insects are recorded in tables, Order by Order. The Orders of Insecta represented in the aquatic fauna are Ephemeroptera (mayflies), Odonata (dragonflies), Plecoptera (stoneflies), Megaloptera (dobsonflies), Trichoptera (caddis flies) and some families of Hemiptera (bugs), Coleoptera (beetles) and Diptera (flies). Neuroptera now only include the true lacewings as the Megaloptera are considered as a separate Order. Marine Trichoptera and Diptera: Tipulidae are included as aquatic records.

Information presented here results from sporadic collecting over many years. In the Tables, sources include references to publications and known specimens. "AMNZ spec.", "NMNZ spec", and "NZAC spec." indicate specimens known to the author in the Auckland Museum, National Museum and Entomology Division collections respectively. Islands and island groups are listed in a general north to south order; an island name in parenthesis after another indicates a particular island of a group. Other explanatory or informative notes are also given in parenthesis. Nomenclature and classification are mostly as in Wise (1965, 1973 and/or 1977), Winterbourn & Gregson (1981) or Towns (1983).

Further information from collecting expeditions, particularly Poor Knights Is and Little Barrier I, are still to be presented as well as individual island faunal lists when these are considered to be sufficiently known.

Rec. Auckland Inst. Mus. 20: 259-271 23 December 1983

Ephemeroptera (Table 1)

It is noticeable that up to nine species of mayflies are recorded for Little Barrier I and few elsewhere. However, some records are from immatures and determinations require confirmation. Current work by Towns (as in Towns 1983) will enable the New Zealand fauna to become better known.

Table 1. Offshore islands Ephemeroptera.

Insecta	Islands	Sources
Family Siphlonuridae		
Nesameletus ornatus	Little Barrier	Winterbourn 1964
Ameletopsis perscitus	Little Barrier	Wise 1956 Winterbourn 1964
Coloburiscus humeralis	Little Barrier	Winterbourn 1964
Family Leptophlebiidae		
Zephlebia (Zephlebia) dentata	Little Barrier	Wise 1956 Winterbourn 1964
Zephlebia (Zephlebia) versicolor	Little Barrier	Winterbourn 1964
Zephlebia (Terama) borealis	Little Barrier	Winterbourn 1964 Towns 1983 AMNZ spec.
? *Zephlebia* spp.	Cuvier	Riddell 1981 AMNZ spec.
Acanthophlebia cruentata	Little Barrier	Winterbourn 1964 Towns 1983
	Great Barrier	Towns 1983
Deleatidium myzobranchia	Little Barrier	Winterbourn 1964
Deleatidium spp.	Little Barrier	Winterbourn 1964
? *Isothraulus abditus*	Little Barrier	Towns & Peters 1979

Odonata (Table 2)

The three known damselfly species in New Zealand are all recorded from offshore islands. During one expedition the tiny but widely distributed *Ischnura aurora aurora* (Brauer, 1865) was seen flying on islands in the Noisies group including Maria I where there is no freshwater. These damselflies may have come from Waiheke I unless the species is breeding in a small pool on Ike rock, a possibility suggested by the record of nymphs in pools on a rock in the Mercury Is group (Watson 1972).

It is interesting that records so far have proved to be for only one species of dragonfly, a species widespread in the North I but little collected in the past (Winstanley 1979).

Plecoptera (Table 3)

Stoneflies have so far only been recorded on the larger Little Barrier and Great Barrier Is which may be the only islands with suitable streams.

Table 2. Offshore islands Odonata.

Insecta	Islands	Sources
Family Coenagrionidae		
Ischnura aurora aurora	Poor Knights (Tawhiti Rahi)	AMNZ spec.
	Noisies (Motuhorapapa)	AMNZ spec.
	(Ike)	AMNZ spec.
	(Maria)	AMNZ spec.
	Cuvier	AMNZ spec.
	Mercury (The Stack)	Watson 1972
Xanthocnemis zealandica	Little Barrier	Wise 1956
	Ponui	AMNZ spec.
	Mercury (Red)	Watson 1972
		Johannesson 1972
	(The Stack)	Watson 1972
Family Lestidae		
Austrolestes colensonis	Great Barrier	AMNZ spec.
	Ponui	AMNZ spec.
Family Corduliidae		
Antipodochlora braueri	Little Barrier	Wise 1956 (as *Procordulia smithii* ?)
		Winterbourn 1964 (as *Procordulia smithii)*
		Winstanley 1979
	Great Barrier	Winstanley 1979

Table 3. Offshore islands Plecoptera.

Insecta	Islands	Sources
Family Eustheniidae		
Stenoperla prasina	Little Barrier	Winterbourn 1964
		Zwick 1979
Family Austroperlidae		
Austroperla cyrene	Little Barrier	Winterbourn 1964, 1965
Family Gripopterygidae		
Zelandoperla n.sp.	Little Barrier	Winterbourn 1964
Zelandoperla agnetis	Great Barrier	Winterbourn 1965 (as *decorata*)
Zelandoperla decorata	Great Barrier	Winterbourn 1965 (as *maculata*)
Acroperla trivacuata	Little Barrier	Wise 1956 (as *Nesoperla trivacuata*)
		Winterbourn 1964 (as *Nesoperla trivacuata*)
		Winterbourn 1965 (as *Aucklandobius trivacuatus*)
	Great Barrier	Winterbourn 1965 (as *Aucklandobius trivacuatus)*
Zelandobius confusus	Little Barrier	Winterbourn 1964 (as *Zelandobius* n.sp.)
		Winterbourn 1965 (as *Zelandobius pallidus* n.sp. -type locality)
Family Notonemouridae		
Spaniocerca zelandica	Little Barrier	Winterbourn 1965 (as *minor*)
		Winterbourn 1968

Hemiptera (Table 4)

The New Zealand-wide endemic pond skaters, *Microvelia macgregori* (Kirkaldy, 1899), occur on water surfaces from Three Kings Is south except, perhaps, on volcanic White I.

The New Caledonia water measurer species, *Hydrometra risbeci* Hungerford, 1938, uncommon in New Zealand, has occurred on one island close to the mainland.

Table 4. Offshore islands Hemiptera.

Insecta	Islands	Sources
Family Veliidae		
Microvelia macgregori	Three Kings (Great)	Woodward 1954 (as *halei*) AMNZ spec.
	Poor Knights (Tawhiti Rahi)	AMNZ spec.
	Little Barrier	Wise 1956 (as *Microvelia* sp. prob. *macgregori*) Winterbourn 1964 (as *Microvelia*)
	Ponui	AMNZ spec.
	Cuvier	AMNZ spec.
	Mercury (Red)	Watson 1972 (as *Microvelia* sp.) Johannesson 1972 (as *Microvelia* sp.)
	Motuhora	AMNZ spec.
Family Hydrometridae		
Hydrometra risbeci	Ponui	AMNZ spec.

Megaloptera (Table 5)

The New Zealand dobsonfly, very common in mainland streams, has only been recorded from three offshore islands.

Table 5. Offshore islands Megaloptera.

Insecta	Islands	Sources
Family Corydalidae		
Archichauliodes diversus	Little Barrier	Wise 1956 Winterbourn 1964 AMNZ spec.
	Great Barrier	NMNZ spec.
	Cuvier	Riddell 1981

Neuroptera (Table 6)

Four species of the New Zealand lacewings have occurred, all four being taken in the Noisies Is group by the author during one expedition. Elsewhere in the offshore islands two common species, particularly *Micromus tasmaniae* (Walker, 1860), are widespread.

One specimen of the widely distributed Australo-Pacific species, *Chrysopa basalis* Walker, 1853, known previously in the New Zealand sub-region only from the Kermadec Is, has been taken on a northern offshore island.

Table 6. Offshore islands Neuroptera.

Insecta	Islands	Sources
Family Coniopterygidae		
Cryptoscenea australiensis	Noisies (Otata)	AMNZ spec.
Family Hemerobiidae		
Drepanacra binocula	Poor Knights (Tawhiti Rahi)	AMNZ spec. NZAC spec.
	Noisies (Otata)	AMNZ spec.
	Great Barrier	AMNZ spec.
	Cuvier	AMNZ spec.
	Aldermen (Ruamahuaiti)	NZAC spec.
	(Ruamahuanui)	NZAC spec.
Micromus tasmaniae	Cavalli (Motukawanui)	Roberts 1979 AMNZ spec.
	Hen & Chickens (Lady Alice)	AMNZ spec.
	Poor Knights (Tawhiti Rahi)	AMNZ spec. NZAC spec.
	(Aorangi)	NZAC spec.
	Little Barrier	AMNZ spec.
	Great Barrier	AMNZ spec.
	Cuvier	AMNZ spec.
	Noisies (Maria)	AMNZ spec. NZAC spec.
	(Motuhorapapa)	AMNZ spec. NZAC spec.
	(Otata)	AMNZ spec. NZAC spec.
	Rakino (On boat)	AMNZ spec.
	Waiheke	NMNZ spec.
	Ohena (Ohena)	NZAC spec.
	Aldermen (Ruamahuaiti)	NZAC spec.
	(Ruamahuanui)	NZAC spec.
	Mayor	AMNZ spec.
Family Myrmeleontidae		
Weeleus acutus	Little Barrier	NZAC spec.
	Noisies (Motuhorapapa)	May 1979 AMNZ spec. NZAC spec.
Family Chrysopidae		
Chrysopa basalis	Moturoa (Whale)	Macdonald 1977 AMNZ spec.

Coleoptera (Table 7)

Species of three aquatic beetle families have been recorded on several offshore islands.

Table 7. Offshore islands Coleoptera.

Insecta	Islands	Sources
Family Dytiscidae		
Liodessus deflectus	Great Barrier	Ordish 1966
Antiporus strigosulus	Mokohinau	Ordish 1966
Copelatus australis	Mokohinau	Broun 1886 (as *Exocelina advena)* Ordish 1966, 1967 AMNZ spec.
Family Scirtidae (=Helodidae)		
	Poor Knights (Tawhiti Rahi)	AMNZ spec.
	Mercury (Red)	Watson 1972 (as Helodidae) Johannesson 1972 (as Helodidae) AMNZ spec.
Family Elmidae		
	Little Barrier	Winterbourn 1964 (as Dryopidae)
	Mercury (Red)	Watson 1972 Johannesson 1972

Diptera (Table 8)

Among the many records for aquatic flies, there are a large number of Dixid and Culicid (mosquitoes) records due to the revisionary work of Belkin (1968). The coastal salt-pool mosquito, *Opifex fuscus* Hutton, 1902, occurs throughout the northern area on the islands and the mainland coast. However, the Great Barrier I record for *Opifex fuscus* is queried as Belkin's locality (1968:164, No. 17) suggests Little Barrier I where Belkin next collected; the species was re-collected at the same locality on Little Barrier I by the present author recently.

The cranefly (Tipulidae) records include some for marine littoral species.

Table 8. Offshore islands Diptera.

Insecta	Islands	Sources
Family Dixidae		
	Cuvier	Riddell 1981
	Mercury (Red)	Watson 1972
		Johannesson 1972
Nothodixa campbelli	Little Barrier	Belkin 1968
	Great Barrier	Belkin 1968
Paradixa neozelandica	Little Barrier	Belkin 1968
	Great Barrier	Belkin 1968
Paradixa fuscinervis	Little Barrier	Belkin 1968
	Great Barrier	Belkin 1968
Paradixa harrisi	Little Barrier	Belkin 1968
	Great Barrier	Belkin 1968
Paradixa sp.	Little Barrier	Wise 1956
		(as *Dixa* (*Paradixa*) sp.)
		Winterbourn 1964
		(as *Dixa* (*Paradixa*) sp.)
Family Culicidae		
Culex (Culex) pervigilans	Poor Knights (Tawhiti Rahi)	AMNZ spec.
	Hen & Chickens (Taranga)	Belkin 1968
	Little Barrier	Belkin 1968
	Great Barrier	Belkin 1968
	Cuvier	Belkin 1968
Culex (Culex) asteliae	Little Barrier	Belkin 1968
	Rangitoto	Belkin 1968
		(type locality)
	Islands of Hauraki Gulf	Dumbleton 1968
		Winterbourn & Gregson 1981
Culex (Culex) quinquefasciata	Little Barrier	Wise 1956
		(as fatigans)
	Rangitoto	Belkin 1968
Coquellitidia (Coquellitidia) iracunda	Great Barrier	Belkin 1968
	Mayor	Belkin 1968
Opifex fuscus	Three Kings	Dumbleton 1968
	Three Kings (Great)	Marks 1958
		Belkin 1968
		AMNZ spec.
	Cavalli (Motukawanui)	Roberts 1979
	Poor Knights	Somerfield 1973
		Watt 1982
	(Tawhiti Rahi)	AMNZ spec.
	Hen & Chickens	Belkin 1968
	Noisies (Maria)	AMNZ spec.
	Rakino	Belkin 1968
	Waiheke	Belkin 1968
		AMNZ spec.
	Mokohinau (Burgess)	Belkin 1968
	(Lizard)	Belkin 1968

	Little Barrier	AMNZ spec.
	(Great Barrier ?)	Belkin 1968
	Cuvier	Belkin 1968
		AMNZ spec.
	Mercury (Red)	Johannesson 1972
	White	Wise 1970
Aedes (Ochlerotatus) antipodeus	Poor Knights (Tawhiti Rahi)	AMNZ spec.
	Little Barrier	Wise 1956
		Belkin 1968
Aedes (*Finlaya*) *notoscriptus*	Little Barrier	Belkin 1968
	Rangitoto	Belkin 1968
Maorigoeldia argyropus	Little Barrier	Belkin 1968
Family Ceratopogonidae		
	Mercury (Red)	Watson 1972 (also as Heleidae)
		Johannesson 1972 (as Heleidae)
	Little Barrier	Winterbourn 1964
Family Chironomidae		
	Little Barrier	Winterbourn 1964
	Cavalli	Roberts 1979
	Cuvier	Riddell 1981
		AMNZ spec.
	Mercury (Red)	Watson 1972
		Johannesson 1972
Family Simuliidae		
Austrosimulium longicorne	Three Kings	Crosby 1981
Family Tipulidae		
	Little Barrier	Winterbourn 1964
	Mercury (Red)	Watson 1972
	Cuvier	AMNZ spec.
Limonia (*Dicranomyia*) *wiseana*	Hen & Chickens	Alexander 1955
		Wise 1965
	?Little Barrier	Wise 1965
Limonia (*Idioglochina*) *fumipennis*	Great Barrier	Wise 1965
?*Limonia* (*Idioglochina*) sp.	Mercury (Red)	Johannesson 1972
Family Psychodidae		
	Mercury (Red)	Watson 1972
		Johannesson 1972
Family Syrphidae		
Eristalis tenax	Cuvier	AMNZ spec.
	Moturoa	MacDonald 1977
		AMNZ spec.
Helophilus sp.	Cuvier	AMNZ spec.
Family Stratiomyidae		
	Mercury (Red)	Watson 1972
		Johannesson 1972
Family Ephydridae		
	Cuvier	AMNZ spec.
Family Muscidae		
	Mercury (Red)	Watson 1972
		Johannesson 1972

Trichoptera (Table 9)

Many species of caddis flies, which occur in many different aquatic habitats, are recorded.

The common marine caddis fly, *Philanisus plebeius* Walker, 1852, is known throughout the northern offshore islands as well as on the adjacent coast. Another marine species, *Chathamia integripennis* Riek, 1977, has recently been described from Paihia in the Bay of Islands on the east coast (not west of Auckland as noted by Riek 1977). This species is now recorded on islands from the Cavalli Is to the Hauraki Gulf, and it is also known to the author in the Firth of Thames as far south as Orere Pt on the mainland. Included in a very recent collection (Oct. 1983) from Rurima Rocks, southern Bay of Plenty are male specimens of both these marine caddis fly species.

Discussion

Of the aquatic insects, ubiquitous species are marine littoral caddis flies (Trichoptera: *Philanisus plebeius*), salt-pool mosquitoes (Diptera: *Opifex fuscus*) and the semiaquatic pond skaters (Hemiptera: *Microvelia macgregori*). These all occur throughout the northern offshore islands, on the mainland and also further south.

Of the lacewings (Neuroptera), *Micromus tasmaniae*, a common and widespread species elsewhere, is the most common species found on the islands.

The evidence concerning aquatics and lacewings so far is for few, if any, species endemic only to the offshore islands. Wind-blown adult winged individuals may account for some species records as the islands are eastward of the main North I and downwind from the prevailing westerly winds. For the same reason, it is not surprising that the established fauna comprises species present in the North Island.

Acknowledgements. Curators of collections in the National Museum, Wellington, and the Entomology Division, D.S.I.R., Auckland, have at various times made specimens available.

Table 9. Offshore islands Trichoptera.

Insecta	Islands	Sources
Family Hydropsychidae		
Orthopsyche fimbriata	Cuvier	Riddell 1981
	Little Barrier	Winterbourn 1964
Aoteapsyche colonica	Great Barrier	AMNZ spec.
Family Polycentropodidae		
Plectrocnemia sp.	Little Barrier	Winterbourn 1964
Polyplectropus puerilis	Cuvier	Cowley 1978 Riddell 1981 AMNZ spec.
	Mercury (Red)	Watson 1972 Johannesson 1972
Polyplectropus sp.	Little Barrier	Wise 1956
	Mercury (Red)	Watson 1972

Family Philopotamidae		
Dolophilodes (*Hydrobiosella*) *mixta*	Little Barrier	Wise 1956 (as *Hydrobiosella stenocerca)*
		Winterbourn 1964 (as *Hydrobiosella stenocerca)*
		Cowley 1978
	Mercury (Great)	Cowley 1978
Family Rhyacophilidae		
	Cuvier	Riddell 1981
		AMNZ spec.
Psilochorema mimicum	Mercury (Red)	Johannesson 1972
Psilochorema sp.	Little Barrier	Winterbourn 1964
	Mercury (Red)	Watson 1972
		Johannesson 1972
Hydrochorema crassicaudatum	Little Barrier	Winterbourn 1964
Tiphobiosis plicosta	Poor Knights (Tawhiti Rahi)	AMNZ spec.
Family Hydroptilidae		
Oxyethira albiceps	Cuvier	AMNZ spec.
Family Conoesucidae		
[? Conoesucidae]	Mercury (Red)	Watson 1972 (as Sericostomatid-like)
Pycnocentria funerea	Cuvier	Cowley 1978
		Riddell 1981
		AMNZ spec.
?*Pycnocentria* sp.	Little Barrier	Wise 1956
Pycnocentria sp.	Little Barrier	Winterbourn 1964
Olinga feredayi	Little Barrier	Wise 1956
		Winterbourn 1964
	Cuvier	Riddell 1981
		AMNZ spec.
Family Oeconesidae		
Oeconesus maori	Little Barrier	Wise 1956
		Winterbourn 1964
Family Chathamiidae		
Chathamia integripennis	Cavalli (Hamaruru)	Roberts 1979 (as *Philanisus plebeius*)
		AMNZ spec.
	Urupukapuka (Bay of Islands)	AMNZ spec.
	Kawau	AMNZ spec.
	Great Barrier	AMNZ spec.
	Noisies (Ike)	AMNZ spec.
	Rangitoto	AMNZ spec.
	Motutapu	AMNZ spec.
	Waiheke	AMNZ spec.
	Ponui	AMNZ spec.
	Motukahaua (W. coast Coromandel)	AMNZ spec.
	Rurima Rocks	AMNZ spec.

Philanisus plebeius	Three Kings (Great)	Wise 1958 AMNZ spec.
	Moturoa (Whale)	MacDonald 1977 AMNZ spec.
	Urupukapuka (Bay of Islands)	AMNZ spec.
	Moturoa (Bay of Islands)	AMNZ spec.
	Poor Knights (Tawhiti Rahi)	AMNZ spec.
	(Aorangi)	NZAC spec.
	Hen & Chickens	Wise 1965
	Goat	AMNZ spec.
	Little Barrier	Wise 1956, 1958 AMNZ spec.
	Great Barrier	AMNZ spec.
	Cuvier	AMNZ spec.
	Noisies (Otata)	AMNZ spec.
	(Maria)	AMNZ spec.
	Rangitoto	Cowley 1978
	Motutapu	Cowley 1978 AMNZ spec.
	Rotoroa	AMNZ spec.
	Ponui	AMNZ spec.
	Motukahaua (W. coast Coromandel)	AMNZ spec.
	Mercury (Great)	AMNZ spec.
	(Red)	Johannesson 1972
	Mayor	AMNZ spec.
	White	Wise 1970 AMNZ spec.
	Rurima Rocks	AMNZ spec.
Philanisus sp.	Urupukapuka (Bay of Islands)	Hayward, Grace & Brook 1981
Family Helicopsychidae		
Helicopsyche zealandica	Mercury (Great)	Cowley 1978
	(Red)	Watson 1972 (as albescens) Johannesson 1972 (as albescens)
Helicopsyche sp.	Little Barrier	Wise 1956 Winterbourn 1964
	Cuvier	AMNZ spec.
Family Leptoceridae		
Triplectides obsoleta	Little Barrier	Wise 1956 Winterbourn 1964
	Mercury (Great)	Cowley 1978

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